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THE

SURGICAL ANATOMY

OF THE

ARTERIES

OF

THE HUMAN BODY.

By ROBERT HARRISON, M.D.,

MEMBER OF THE ROYAL COLLEGES OF SURGEONS OF LONDON AND IRELAND,

PROFESSOR OF ANATOMY AND PHYSIOLOGY IN THE SCHOOL OF SURGERY IN DUBLIN, ETC. ETC.

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TO

THE PRESIDENT,

MEMBERS, AND LICENTIATES,

OF

THE ROYAL COLLEGE OF SURGEONS

IN IRELAND,

THE FOLLOWING PAGES

ARE RESPECTFULLY INSCRIBED

BY THEIR

VERY OBEDIENT SERVANT,

ROBERT HARRISON.

CONTENTS.

	Page.
PREFACE,	i
Preface to the first Edition,	iii
General Observations on injecting the Arterial System,	1
AORTA,	4
Arch of,	6
Anomalies in Branches of,	15
Right Coronary Artery,	20
Left Coronary Artery,	21
ARTERIA INNOMINATA,	22
Middle Thyroid Artery,	ib.
Operation of tying Arteria Innominata,	16
COMMON CAROTID ARTERIES,	25
Operation of tying the Common Carotid Artery,	31
EXTERNAL CAROTID ARTERY,	36
Operation of tying the external Carotid Artery,	38
Superior Thyroid Artery,	40
Operation of tying it, sometimes required,	42
Lingual Artery,	43
Operation of tying this Artery considered,	47
Facial Artery, Course, relative Anatomy, Divisions of,	ib.
Muscular Branch,	55
Occipital Artery, Course, Branches, Inosculations of,	56
Posterior Auricular Artery, Course and Termination of,	58
Ascending Pharyngeal Artery,	61
Transverse Artery of the Face,	63
Superficial Temporal Artery,	64
Internal Maxillary Artery,	68
Relative Anatomy of the *Parotid Gland*,	69
Three Orders of Branches of the internal Maxillary Artery,	75
INTERNAL CAROTID ARTERY,	81
Ophthalmic Artery,	94
Arteries of the Brain,	104
SUBCLAVIAN ARTERIES,	107
Right Subclavian Artery, relative Anatomy of,	108
Left Subclavian Artery,	11

Page.
Operation of tying the Subclavian Artery, considered, 115
External Operation of tying the Subclavian Artery, 117
Internal Operation of tying the right Subclavian Artery, 121
Vertebral Artery, Course of, ... 128
Basilar Artery, ... 131
Internal Mammary Artery, ... 136
Thyroid Axis, ... 139
Inferior Thyroid Artery, ... ib.
Ascending Cervical Artery, ... 140
Transversalis Colli Artery, ... 143
Deep Cervical Artery, ... 145
Superior Intercostal Artery, ... 146
AXILLARY ARTERY, Course of, ... 149
Operation of tying it considered, ... 151
Acromial Thoracic Artery, ... 160
Superior Thoracic Artery, ... 161
Alar Thoracic Artery, ... ib.
Long Thoracic Artery, ... 162
Subscapular Artery, ... ib.
Posterior Circumflex Artery, ... 165
Anterior Circumflex Artery, ... ib.
BRACHIAL ARTERY, ... 169
Superior Profunda Artery, ... 174
Inferior Profunda Artery, ... 175
Anastomotica Magna, ... 176
Operation of tying the Brachial Artery, . . 181
Aneurism at the bend of the Elbow, . . . 182
Arteries of the fore Arm, ... 191
RADIAL ARTERY, ... 193
Radial Recurrent, ... 195
Superficialis Volæ, ... 196
Anterior and Posterior Arteries of the Carpus, . ib.
Arteries of the Thumb, ... 197
Radial Artery of the Index Finger, . . . 198
Deep Palmar Artery, ... 199
Operation of tying the Radial Artery, . . . ib.
ULNAR ARTERY, ... 202
Recurrent Arteries, ... 203
Anterior and Posterior of the Carpus, . . . 205
Communicating Artery, ... ib.
Superficial Palmar Artery, ... ib.
Digital Arteries, ... 207
Operation of tying the Ulnar Artery, . . . 208
INTEROSSEOUS ARTERY, ... 210
General Observations on the Arteries of the Neck and Superior Extremity, ... 215

PREFACE

TO THE PRESENT EDITION.

SINCE my booksellers have informed me, that a new edition of this work would shortly be required by the public, I have lost no opportunity of correcting those inaccuracies which have been observed in the original, but no doubt many still remain which have escaped my notice. I have abridged some parts, added to others, and altered many, and with an anxious desire to secure a continuance of that approbation which has been so very generally bestowed on the former editions, I have endeavoured to improve the present, not so much by an increased number of pages, as with additional references to

sources of practical information, and with allusions to comparative anatomy, a science which at the present day so deservedly engages the attention of the medical world.

1, *Hume-street, Stephen's-green.*

PREFACE

TO THE FIRST EDITION.

My object in writing a description of the Surgical Anatomy of the Arteries, is to facilitate the study of the relative connexions of every blood-vessel whose magnitude can render it of practical importance, or whose peculiarity of course and termination can elucidate any physiological inquiry.

It is generally observed that a Student attends with most earnestness, and consequently with most benefit, to such anatomical descriptions as are interwoven with practical or physiological remarks: and again, that those practical or physio-

logical inferences are most appreciated which are drawn from anatomical relations.

Under this impression I have ventured to publish the following pages. The pupil will, I trust, find the plan which I have pursued, useful, in directing and assisting his progress in the study of a science difficult and complicated, but, in his profession, useful above every other.

The description of every artery of importance, I have in general prefaced by some observations as to the best mode of performing the dissection, or displaying the relative anatomy of the parts concerned.

In the description of the individual arteries, I have been particular only in portion to the practical or physiolo-

gical importance of each ... ing the relations of each ... considered, *first*, its coverings ... the parts it lies upon ... which accompany it; *fourthly*, the vessels which it distributes ... and *lastly*, I have endeavoured to direct the Student's attention to such practical inferences as may be deduced from a review of these several circumstances combined.

As to the several varieties of every large artery, I have described all such as are of importance in a practical point of view, from being connected with operations, or endangered in accidental injuries, or occasionally of essential service in establishing collateral circulation.

Although in many of the descriptive parts I have availed myself of the writ-

ings of others, yet the reader may be assured, that every description has been confirmed by numerous dissections on a great number of bodies.

It is not my intention to enter into a very minute or particular account of every small ramification of each artery; several works in the English and other languages contain an enumeration of the smallest branches, and of every variety in their origin and course that has been hitherto observed. These writings have certainly been of infinite service, and must ever be studied with interest and advantage; it appears to me, however, that an acquaintance with the relative anatomy of the principal arteries is more essential to the Surgical Student, than an extended nomenclature or systematic arrangement of the minute and numerous

al ramifications.

In the practical remarks that are offered, I have avoided, as much as possible, references to authors or long quotations; this, I trust, will not be construed into disrespect to those who have so largely contributed to the science: in a work intended, as this is, principally for the dissecting-room, I conceive conciseness and brevity to be most important and highly conducive to the Student's progress and convenience, as his attention, instead of being diverted *from*, will be thus more steadily directed *to* the subject immediately before him.

At the time I commenced this work, I contemplated having coloured plates, explanatory of the relative anatomy in those situations where operations on the arteries may be required; on reflection, however, I abandoned the idea, as the number of drawings that were required

must have added considerably to the size and expense of a work designed for the Student in the dissecting-room, and as in this city there is such abundant opportunity for cultivating practical anatomy, and studying it in the "book of nature."

In the following pages, I feel fully conscious of several imperfections in the description, as well as inaccuracies in the composition; the former however, I trust, will not be found of any material consequence, and the latter, I hope, will be excused in a work whose sole object is practical utility.

SURGICAL ANATOMY

OF THE

ARTERIES.

PREPARATORY to commencing the dissection of the arteries, they should be injected from the heart. To introduce a pipe into this vessel, the student must make a longitudinal incision through the integuments covering the sternum, and divide that bone with a saw in the same direction; the edges being forcibly held asunder by an assistant, or by a block of wood placed transversely between them. The pericardium should be opened, and the serous membrane that connects the aorta to the pulmonary artery being divided, a ligature may be passed loosely round the former. An incision should next be made into the left ventricle of the heart, or into the aorta immediately above its origin, and the pipe, which should be furnished with a stop-cock, being introduced into the artery for a short distance, is to be secured by the ligature being firmly tied, and its ends brought up and fastened to the arms of the pipe. The artery should be exhausted of blood and air as perfectly as possible, and then the fluid (of sufficient temperature to retain its fluidity and its component parts mixed) is to be injected by a large

syringe which should be forced at first quickly, afterwards gradually, and as long as moderate resistance only is given by the vessels; the stop-cock being then turned the syringe is to be withdrawn. The subject should be left for a few hours before the dissection is commenced, to allow the injection to congeal. In this way all the arterial branches, except the coronary arteries, may be filled sufficiently well for the purposes of mere dissection; but should the student wish to make preparations of particular parts, each part ought to be injected separately, being first immersed in very warm water for two or three hours. Should he desire to trace the coronary arteries minutely, the injection may be forced from the aorta towards the heart; or when the heart is detached from the body, a small pipe may be inserted into one of these vessels, and the injection propelled through their free inosculations, so as to fill the branches of both.*

It is customary to commence the dissection of the arterial system at the root of the aorta, and to trace its ramifications throughout all parts of the body; in this order is the following description: should the student, however, wish to direct his attention to any individual artery, the index will refer him to the page in which such vessel is described, and he may thus

* For more particular directions as to the art of injecting and preserving vascular preparations, the reader is referred to the *Dublin Dissector*, page 510, *2d edition*, in which he will also find a few useful formulæ for preparing those injections in most common use.

undertake the dissection of any particular part of the arterial system, without commencing at the aorta.

Varieties in the origin and course of arteries are very commonly observed; to give an accurate description of all such as have been enumerated by authors would be almost impossible; the student should first make himself acquainted with what we are in the habit of considering as the regular order, and afterwards with those irregularities which are most frequently noticed.

I may here remark, that many of those deviations from the ordinary arrangement, which are so frequently observed, not only in the arterial, but also in the other systems of which the human body is composed, and which are very generally regarded as curious "*lusus naturæ*," or as the effects of disease, are found to exist in other divisions of the animal kingdom, as the ordinary or natural arrangement; this fact gives rise to many interesting reflections, which, however, I shall here refrain from pursuing, but shall, in the following pages, occasionally call the reader's attention to some examples, strikingly illustrative of the above stated physiological position.

THE AORTA.

To examine the origin and course of this large artery, whose branches extend through all parts of the body, the thorax may be opened in the following manner: the left half of the sternum (which bone has already been divided for the purpose of injecting the subject), must be separated together with part of the second, third, and fourth ribs; these bones should be sawed through, anterior to their centre, and then everted together with the sternum; the cartilage of the first rib being cut through, but that bone itself left in its situation; some cellular membrane behind the sternum must now be removed, and the pericardium being fully opened, the commencement of the aorta is brought into view.

The aorta arises from the upper part of the left ventricle of the heart, directly in front of the left auriculo-ventricular opening, and behind the pulmonary artery; the fleshy fibres of the ventricle are not continuous with the fibres of the aorta; both this vessel and the pulmonary artery are connected with the heart in the following manner:—first, the serous layer of the pericardium being continued from the surface of the heart upon the arteries at their origin, serves to connect them;—secondly, the lining membrane of the heart is continued into each vessel, forming at their commencement the semilunar valves;—thirdly, the middle or fibrous coat of each artery, is intimately connected to the fleshy fibres of the heart, by three

semicircular portions, whose abruptly defined convex edges are turned towards the ventricles. These three festoon-shaped roots, at the commencement of each artery, cover the small pouches (the sinuses of Morgagni) that lie outside of the semilunar valves; and thus these sinuses are rendered sufficiently firm to resist distention, as the blood is strongly pushed into them during the systole of the arteries. In the angle between the extremities of each two of these, the wall of the artery is formed only by the lining membrane of the heart and the serous layer of the pericardium, which are here in apposition. In old persons I have frequently found the convex margins of these three roots of the fibrous coat of the aorta very firm, and almost rigid from bony deposit, the texture and pliancy of the valves, however, not being in any degree impaired; I have not noticed any similar change at the commencement of the pulmonary artery.* If the opening of the aorta be inspected from the cavity of the ventricle, it appears of a triangular shape, and of much smaller caliber than the artery is immediately above

* Ossifications exist naturally in this situation in the pig and in many of the ruminants; the common ox is a good example, in it are two very strong and semiannular bones enveloped in the fibrous coat of the aorta, with the fleshy fibres of the ventricle inserted into the cardiac edge of each; in the stag, the corresponding bones are cruciform, and are placed near the septum of the ventricles. Carus states that these are formed about the third or fourth year of life, and are less perfect in the female. Carus' Introduction to Comparative Anatomy, translated by Gore, vol. ii. page 298.

this, for then it swells out into the great sinus of Morgagni.

If the attention of the student be directed to the relation which the origin of the aorta bears to certain points in the parietes of the thorax, he will find that this part of the artery is opposite the upper edge of the cartilage of the fourth rib of the left side, at its junction with the sternum, and to the left side of the body of the fourth dorsal vertebra. The vessel, emerging from between the pulmonary artery and tip of the right auricle, passes upwards, forwards, and in the direction of the heart's axis, to the right side; then bends backwards and to the left, and descending as far as the left side of the body of the third dorsal vertebra, completes what is called the arch of the aorta. This arch, for the purpose of description, may be divided into three portions; the anterior, or ascending; the middle, or transverse; and the posterior, or descending. The first, or ascending portion of the arch of the aorta, is rather to the right side of the spinal column, it rises as high as the upper edge of the cartilage of the second rib on the right side, passing in the direction of the heart's axis, and describes a curve which is convex upwards, forwards, and to the right side; almost all this portion is within the pericardium. Its commencement is covered by the pulmonary artery, it afterwards lies between this vessel and the superior vena cava, the left auricle and right pulmonary artery are behind it, and the pericardium and some cellular membrane separate it from the sternum, from which, when distended, it is only about

a quarter of an inch distant. The left vena innominata is closely connected to its upper part by a dense fascia, and overlaps it towards the right side. This portion of the arch is often very much dilated without being diseased, and is therefore sometimes named the great sinus of the aorta, the highest point of which is nearly on a level with the line of connexion between the first and second pieces of the sternum :* this dilatation is not cylindrical, it is chiefly towards the front and right side, and is probably a mechanical effect, slowly induced by the continual impulse of the blood against the parietes of the tube, which at this point changes its direction.

In the child, accordingly, it is by no means so large in proportion, as in more advanced life; nor is it so close to the sternum in the young, as in the old subject. In the latter, the coats of the artery in this situation are frequently found studded with calcareous deposits, a morbid change of structure, which may be considered the ordinary precursor of aneurism in this part of the arterial system.

* Somewhat analogous to this dilatation, which remains for years unproductive of danger, are those natural dilatations which have been observed in the aorta of the peccari, also in that of the porpoise and other amphibia, as stated by Carus and Meckel. Notwithstanding these authorities, I must, however, remark, that I have not observed any such appearances in a porpoise I carefully dissected some time since, nor in a seal which I had lately an opportunity of examining: there are, doubtless, many peculiar circumstances in the vascular system of these as well as of others of the amphibia, such as the numerous vascular plexuses placed in the chest, the sinuses of large veins, &c.

The middle portion of the arch runs almost horizontally backwards and to the left side, ending opposite the body of the second dorsal vertebra; it rests on the trachea a little above the division of that tube; its termination is connected to the pulmonary artery, by the ligamentous remains of the ductus arteriosus; the par vagum of the left side crosses it, and its recurrent branch hooks under it; from this part of the arch arise the three great vessels to supply the head and superior extremities.

The third, or descending portion of the arch, is continued from the second downwards, and backwards, between the spine and left lung, and ends at the left side of the body of the third or fourth dorsal vertebra;* these bones, in old subjects, are often indented on their left side, the pressure of the artery

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* On comparing the relation of the arch of the aorta to the parietes of the thorax in several subjects, I have observed very striking differences to exist, depending, I believe, partly on age, and partly on the form of the chest, as well as on other circumstances. The younger the subject, the higher in the chest has been the heart, and of course the arch of the aorta. In some females, in whom the chest is short, and the sternum very prominent, the heart and great vessels have been found elevated, whereas, in old, weak, and much emaciated individuals, and in some where the thorax has been peculiarly long and flat on the sides, I have been surprised to find the heart and aorta so low in the cavity, as that the termination of the arch has in some cases been opposite to the fifth dorsal vertebra; the length of the arteriæ innominata, carotid, and subclavian, has in such cases been very remarkable.

causing their absorption;* the œsophagus and thoracic duct lie on the right side, and somewhat in front of this portion of the arch. The aorta then descends along the left side of the vertebral column, under the name of the thoracic aorta, the description of which shall be resumed after that of the branches of the arch. There is no exact distinction between the termination of the arch, and the commencement of the thoracic aorta; nor, therefore, does the one deserve the name of thoracic more than the other.

Before the student traces any of the branches of the aorta, he should pay particular attention to the different relations its arch bears to several surrounding parts, and consider some of the effects that aneurism of this vessel is likely to produce. He should observe the curve which the aorta makes in this course, how it first advances near to the sternum, and then recedes to the vertebræ; thus the aneurismal tumour may incline forwards, and cause the absorption of the sternum and cartilages of the second and third ribs on the right side; or may press backwards towards the vertebræ, and produce caries in them, hence pain and partial

* Indeed, the region of the spine from the second to the sixth dorsal vertebra, is often distinctly curved in the lateral direction, the convexity towards the right side; this curve is most frequently found in delicately formed females, in whom it commences a short time before puberty, it often causes the protrusion or elevation of the right scapula. I have not observed this curvature in children; it is doubtful whether it depends on the pressure of the heart and aorta, or on the unequal action of the dorsal and scapular muscles; perhaps both causes co-operate to produce it.

paralysis in the superior extremities, as in idiopathic disease of the spine. The connexion of the arch of the aorta with the trachea will account for its enlargement producing irritation in that tube, and thus exciting the unceasing cough which so generally attends that disease. He should also remark the close connexion between the artery and the vena innominata, which explains how the lividity of the countenance and varicose condition of the cervical veins may depend on the mechanical pressure of this disease. The student should next dissect the different parts which pass through the arch of the aorta, and observe how its concavity looks downwards, and to the left side, bending round the root of the left lung. The right pulmonary artery is the first part that he will find contained within the arch; behind this is the left branch of the trachea, and behind this is part of the left auricle of the heart, and the recurrent branch of the left pneumogastric nerve, posterior to which, but not passing through the arch, are the œsophagus, and the thoracic duct. In this situation also is a mass of dark-coloured conglobate glands, called bronchial, which are found more frequently diseased than glands in any other situation; some of these are continued along the ascending branches of the artery to the neck, and are connected by cellular membrane and vessels to the lymphatic glands of that region; the student may very generally observe one or two of these glands buried in the recess between the arch of the aorta and vena cava descendens; these I have frequently found diseased, and can easily conceive how their enlargement or suppuration may pro-

duce considerable inconvenience to the surrounding parts; that the returning blood may be impeded in the veins; that the arteries, the air-tube, &c., may be compressed, and thus give rise to a train of complaints, and even apparent symptoms, in many respects similar to those of aneurism. These glands frequently increase in size so much, that they rise out of the chest, into the cervical region; they contain a sort of semi-fluid, or soft cheesy matter, that conveys to the touch an imperfect sense of fluctuation; they sometimes appear constricted or indented by the interclavicular ligament, and cervical fascia, which last is very tense between the two clavicles; these tumours often have a dull pulsation, communicated to them from the aorta or its large branches; the integuments, too, are sometimes discoloured, and in some instances it requires very careful examination into the history and symptoms, as well as of the appearances, to distinguish these from aneurismal tumours of the aorta, or arteria innominata.

The student cannot fail to observe, how such an examination in the living body may be facilitated by making it in a proper position. As the subject lies on the table, with the head thrown back, the muscles and fascia of the neck are tense; but if he raise the head, and support it, these parts become relaxed, and he can even insinuate his fingers a short distance into the cavity of the thorax. In the examination of the living body, either in the sitting or recumbent posture, the head should be bent forwards, the shoulders also should be inclined in the same direction, in order to

relax the interclavicular ligament; in some cases too, by directing the head a little to one side, as well as downwards, and by observing the motions of the trachea, useful information may be obtained.

When we reflect on the number and importance of the several organs connected to this small part of the arterial system, we cannot be surprised to hear how equivocal are the symptoms of its diseases, how numerous its sympathies; and we can then also easily understand, why aneurismal tumours may take different directions, and burst in different situations.

If we look at the commencement of the arch, we see nearly two inches of it contained in the pericardium, inclosed with the heart in the same serous cavity; it cannot then be a matter of surprise, that considerable difficulty should exist in distinguishing between aneurism of this part of the artery and organic diseases of the heart, or of its investing membrane.*

* Laennec well remarks, there are few diseases so insidious as this—the first indication of its existence in some cases, is the death of the individual as instantaneously as if by a pistol bullet, even in persons who were previously believed to be in most perfect health. Aneurism of the aorta has therefore no symptom *peculiar* to it; all those noticed by authors being indicative merely of change, or compression of adjoining organs; even when the aneurismal tumour has made its way through the parietes of the chest, it is not always distinguishable from tumours of a different kind. Percussion will enable us to detect a tumour of *large* size in the mediastinum, or near the back, but not to discriminate its nature, nor does the stethoscope remove the difficulty of diagnosis, although, no doubt, in many cases it will

If the tumour be situated higher up, we can understand why it should occasionally ascend into the neck, and resemble an aneurism of the arteria innominata, or carotid; should it incline backwards, towards the vertebræ, lungs, or œsophagus, it may produce complaints not unlike caries of the vertebræ, phthisis pulmonalis, or stricture of the œsophagus. From an attentive observation also of the anatomical relations of the arch, we shall be able to comprehend the different directions the aneurismal tumour may take, previous to its causing death by bursting; if at the commencement of the vessel, it may open into the pericardium, or it may come forwards, and cause the absorption of the sternum and cartilages of the third and fourth ribs on the left side; if situated higher up,

---

afford valuable assistance; but even to those versed in the practice of percussion and auscultation, there are no decided pathognomonic signs to discriminate between aneurism of the aorta, pericarditis, and polypi of the heart. See Diseases of the Chest, by Laennec, translated by Forbes, page 678. See also, the excellent work on Maladies du Cœur, by Bertin. This author, however, considers that by means of auscultation, the diagnosis of aneurisms of the aorta, is not more difficult than that of the heart and lungs, page 143, and that the pulsations of aneurism of the *substernal* portion of the aorta, may be certainly distinguished from the actions of the heart, by the intensity of the shock over the seat of the aneurism, and by certain peculiarities in the sound, which, though difficult to describe in words, yet can never be mistaken by the ear when once familiar with them, page 167. In this excellent treatise, which is well worthy the attention of the surgeon, many cases are detailed in which Bertin was led, by means of auscultation, to form a correct diagnosis.

it may appear through the cartilages of the second o third rib, as they join the sternum on the right side or it may ascend into the neck, and incline a litt forwards, and being constricted by the extremities c the clavicles and interclavicular ligament, may tak the same direction as, and closely resemble aneuris of the arteria innominata, or of the left carotic Cases are on record of aneurisms near the origin c the aorta, thus bursting into the pericardium, or be coming attached to the pulmonary artery,* and open ing into it; in other cases the tumour, directed back wards, has opened into the air cells of the lungs, int the trachea, or œsophagus,† or into the left pleura, c by causing absorption of the heads of the ribs an sides of the vertebræ, it has protruded through th integuments at the side of the spine.

From the arch of the aorta arise five arteries i general; two (coronary) immediately above the sma sinuses of Morgagni; and three (arteria innominat left carotid, and left subclavian) from the middle c transverse portion of the arch, immediately beyon the great sinus. Exceptions to this order not unfr quently occur;‡ without entering into a particula

* See an interesting case recorded by Dr. Wells in the Medi cal and Surgical Transactions of London, vol. iii. page 85.

† See Bertin, Maladies du Cœur, pages 109 and 110. Nu merous single cases of aneurism of the aorta will be found i the modern periodical Medical and Surgical Journals.

‡ The student who is engaged in dissection, may pass ove the few following pages, and at once proceed to the descriptiv anatomy of the coronary arteries, page 20.

enumeration of all those that have been described by authors, or have been observed by myself, I may remark that the varieties which occur in this part of the arterial system may be arranged under seven heads; 1st, anomalies in the course and position of the arch itself; 2nd, in the coronary arteries which may be increased or diminished in number; 3d, in the origin and distribution of the three great branches which arise from the middle of the arch; 4th, these branches may be reduced to two; 5th, they may be increased to four; 6th, they may be increased to five; and 7th, they may be increased to six. Many of these anomalies will be found to be only repetitions or imitations of the natural arrangement of the same parts in other animals, and others may be considered as merely the union of parts naturally separate, or the separation of parts naturally united. We shall select a few examples of each of these anomalies; 1st, as relates to the aorta itself: the arch is sometimes partially reversed, passing over the right bronchus to the front, and then to the left side of the spine.* Sometimes it is wholly reversed, the curve being continued from left to right, as far as the right side of the spine, along which the descending aorta holds its course; in such cases of lateral inversion of the arch, I believe, the position of the heart and great vessels is also reversed, the apex of the former pointing to the right side: in such cases too, there will generally be found more or less com-

* See Meckel, Man. d'Anat. vol. 2. page 311. Phil. Transactions, 1793, a case by Abernethy.

plete transposition of the principal viscera of organic life; the liver, for example, will be in the left hypochondrium, and the spleen and stomach in the right. In the museum of the School of Surgery, there is a preparation in which the aorta and vena cava inferior are thus transposed, and in the museum of the College of Surgeons there is a similar preparation recently obtained in which the great vessels, and the principal viscera of the abdomen of an old person were all reversed; a similar specimen has also been lately presented to the College by Mr. Kirby. Sometimes the aorta divides at its very root into two branches, which encircle the trachea and œsophagus, and then unite to form the descending aorta; in one recorded case of this anomaly, five semilunar valves existed at its root, shewing as it were a disposition to an earlier division, or to a double origin; this singular arrangement, which is noticed by Tiedemann, Meckel, and others, is very analogous to the natural structure in the reptile and amphibious division of vertebral animals. Sometimes when the aorta thus divides soon after its origin, one branch descends abruptly, and becomes the descending aorta, the other ascends perpendicularly, and terminates in three arms (like a cross), the right being the innominata, the left the left subclavian, and the continuation of the vessel, the left carotid: this is well represented by Tiedemann:* in the museum of the School of Surgery, there is a good specimen of this anomaly taken from an adult subject; this arrange-

* Plate iii. fig. 11.

ment is the natural structure in many of the mammalia with long necks, such as the camel, horse, &c.

Sometimes the vertebral extremity of the arch has been found much contracted, and even perfectly closed (yet free from disease), in these cases the circulation has been maintained by collateral vessels which were found greatly enlarged, and which were principally communicating branches between the upper and middle intercostal arteries.*

2d. Anomalies in the coronary arteries are rare; sometimes there is but one coronary artery, this is the case in the elephant;† as allied to this variety, we may observe, that one coronary artery is sometimes very small, and its deficiency is made up by the larger size of the other: sometimes there are three, or even four coronary arteries; the supernumerary branches, however, are always very small.‡

3d. Varieties as to origin and distribution in the three large branches which arise from the middle of the arch, are occasionally observed; thus, the two carotids may arise by a common trunk between the two subclavians,§ this, according to Cuvier, is the natural arrangement in the elephant; or, there may be on the

* Meckel, vol. ii. page 313. Dessault's Surgical Journal, vol. ii. page 104, and Med. Chirur. Trans. vol. v. page 291.

† Camper's Works, vol. ii. page 133.

‡ Green's Varieties in the Arterial System, page 8. Barclay's Description of the Arteries, page 6. Meckel's Anat. vol. ii. page 315.

§ Tiedemann, plate III. fig. 11. Cuvier's Anat. Comp. vol. iv. page 254.

right side, first a common trunk for the right subclavian and both carotids, then the left vertebral, and lastly, the left subclavian; or again, we may have an innominata on the left side, while the right carotid and right subclavian may arise distinctly;* or the right subclavian may arise from the descending aorta, and pass behind the trachea and œsophagus to the right side. In this last mentioned variety, which is by no means uncommon, the inferior laryngeal or the recurrent nerve will not be found to encircle this artery, this nerve, too, in such cases, will be generally found, I believe, to arise higher in the neck, and by several branches which, however, will be distributed as usual to the larynx and trachea, to the œsophagus and thyroid body.

4th. Variety, or that with only two primary branches is rare: there may be two innominatæ; Cuvier states this to be the structure in the dolphin:† or, the right innominata may give rise to the two carotids and right subclavian, as in the marmot and Guinea pig: this arrangement, slightly modified, is also observed in the bear, lion, and dog. In such a variety in the human subject, the left carotid must cross the trachea, and should therefore be exposed to some danger in tracheotomy; sometimes one of the two trunks will furnish the two carotids, the other the two subclavians.‡

5th. Variety, or that with four primary branches:

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* Meckel, vol. ii. p. 322.

† Cuvier's Anat. Comp. vol. iv. p. 249.

‡ Green's Varieties, p. 7.

this is a very common anomaly, and presents itself under different forms; that which I have most frequently observed is, that the additional branch has been the left vertebral artery, arising between the left carotid and subclavian: sometimes the fourth branch will be either the inferior thyroid artery of the right side, arising from the arteria innominata, or a middle thyroid artery arising in the same situation, and ascending in front of the trachea to the gland: the fourth branch I have frequently found to be the right subclavian artery, arising distinctly from the descending portion of the arch, and thence passing across the spine to the right side, behind the œsophagus, or between it and the trachea: I have met with many examples of this variety. In the second volume of the Dublin Hospital Reports, a singular case is reported by Mr. Kirby, of a woman, in whose throat a small bone had stopped. The bone perforated the œsophagus, and wounded this artery, which took the unusual course now described. Sometimes the fourth branch will be caused by the internal and external carotids, arising on one side separately from the arch.

6th. Variety, or that with five primary branches: this is much less frequent than that last described; the subclavians and carotids may arise separately, with the addition of the left vertebral, or of a thyroid branch, or of the internal mammary artery.

7th. Variety, or that with six primary branches, is still more rare than the last; I have seen two specimens of it; in each, the two subclavians, the two carotids, and the two vertebral arteries arose separately

from the aorta; each vertebral between the corresponding carotid and subclavian.*

ARTERIA CORONARIA DEXTRA VEL ANTERIOR,

Arises immediately above the floating edge of the anterior semilunar valve, beneath the pulmonary artery, and soon appears between this vessel and the right auricle; it supplies the right side of the heart, and runs in a very tortuous manner towards the right side, between the right auricle and ventricle, covered by the former, and arriving at the anterior thin edge of the heart, divides into three branches, a superior, inferior, and posterior. The superior continues in the groove, between the auricle and ventricle, around the base of the heart, gives off at right angles numerous tortuous branches to the right auricle and ventricle, particularly to the latter, and anastomoses with a similar branch from the left or posterior coronary artery.

The second, or inferior branch, runs from the base of the heart along the anterior thin edge of this organ to the apex, anastomosing there with several small branches from the left coronary: this branch supplies the parietes of the right ventricle.

The third or posterior branch appears to be the continuation of this coronary artery, it bends downwards, and backwards, and runs in that line or groove which is observed on the inferior surface of the heart, separating this from the posterior surface; this branch also joins the anastomosis at the apex, having supplied

* Tiedemann, page 51. Meckel, vol. ii. page 322.

the back part of the right ventricle and the septum cordis.

ARTERIA CORONARIA SINISTRA, VEL POSTERIOR,

Is smaller than the right, arises immediately above the floating edge of the left semilunar valve, and appears between the pulmonary artery and the left auricle; it descends along the left side of the heart, and very soon divides into two branches, a superior and inferior. The superior runs backwards round the base of the heart, between the left auricle and ventricle, supplying the parietes of these cavities with numerous branches, and anastomosing with the superior branch of the right coronary. The base of the heart is thus completely encircled by these two vessels.

The inferior branch descends along the anterior border of the septum cordis, to the apex of the heart, and there anastomoses with the branches of the right coronary. Both coronary arteries supply the fleshy substance of the heart; the largest branches go to the ventricles; small ramifications also extend along the vessels, and, being reflected to the pericardium, anastomose with arteries from the mammary, phrenic, &c.*

The ascending portion of the arch sends off only the coronary arteries, but from the transverse or middle portion three large vessels arise, the arteria innominata is the most anterior, the left carotid next,

* The coronary arteries are frequently diseased, but aneurism of them is rare, they are subject to inflammation and calcareous deposits; in hypertrophy of the heart, they have been found much dilated.—*Bertin*, page 414.

and the left subclavian is the most posterior; the two former are very near each other, and almost conceal the trachea at their origin, but the left subclavian arises at some distance behind the carotid; these three vessels arise above the reflection of the serous layer of the pericardium, and are crossed by the left vena innominata immediately above their origin.

ARTERIA INNOMINATA,

Arises from the summit of the arch, ascends obliquely to the right side, and passing over the trachea, divides opposite the sterno-clavicular articulation into the right carotid and subclavian arteries. In the adult it measures from one inch to an inch and a half in length; it is usually longer and larger in proportion in the male than in the female.

This artery lies upon the trachea, it is also connected to the right pleura; at its division it is opposite to, but at a considerable distance from the longus colli muscle; it is covered immediately at its origin by the vena innominata, by the sterno-hyoid and sterno-thyroid muscles, also by the upper piece of the sternum; at its termination, the sternal portion of the sterno-mastoid muscle also covers it; the point at which it divides is posterior to the division between the two portions of that muscle. No branch arises regularly from this artery, before its division; I have often, however, observed a small one to ascend from its middle along the front of the trachea to the thyroid gland and cellular membrane beneath it. I have so frequently seen an artery in this situation, that I have

been in the habit of describing it under the name of the *middle thyroid artery*: this is so common an occurrence, that it should be kept in the recollection of the practitioner, and serve as an additional reason for proceeding with great caution in the operation of tracheotomy. This sometimes arises from the arch of the aorta between the arteria innominata and left carotid. The arteria innominata in some subjects ascends much higher than usual in the neck before it divides; in some persons I have seen it distinctly pulsating on the trachea above the sternum. In children the space for tracheotomy is very limited, and the student should pay particular attention to the inconsiderable portion of the trachea that can be exposed between the thyroid gland above, the arteria and vena innominata, the left carotid, and remainder of the thymus gland below; the deep thyroid veins also descending to the vena innominata, obscure the trachea very much. These, together with the great mobility of this tube, add to the danger and difficulty of this operation.

The operation of tying the arteria innominata, is one of modern date, and although no successful case has hitherto occurred, yet as it has been satisfactorily ascertained, that the circulation in the head and right arm is not interrupted by this artery being obstructed, and as circumstances might occur to require the surgeon to pass a ligature around it, the student may practise the operation on the dead subject in the following manner:—the subject being placed on the back, and the neck extended, by the shoulders being raised a little from the table, the artery is drawn

somewhat out of the thorax into the neck; make an incision through the integuments, two inches in length, along the anterior edge of the sterno-mastoid muscle, terminating at the sternal end of the clavicle; from this make a transverse incision outwards above the clavicle, about one inch and a half long, the flap of the integuments should be raised a little upwards and outwards, the sternal part of the sterno-mastoid is thus fully exposed; behind it pass a director, on which this portion of the muscle, as also a few of its clavicular fibres, are to be divided. In performing this part of the operation, care should be taken to avoid those small veins and arteries that lie behind this muscle, by keeping the director close to its posterior surface. The muscle being thus divided, you gently press to either side some loose adipose substance that now appears, and the surface of the sterno-hyoid and thyroid muscles will be exposed; the director should then be carefully insinuated behind these individually, keeping the instrument close to their fibres; these being divided, and the sides of the wound separated by broad retractors, and by carefully tearing through a strong fibro-cellular membrane, the trunk of the right carotid artery may be seen arising from the arteria innominata, the jugular vein, and par vagum being to the acromial side; the left vena innominata should be depressed, and the curved aneurism needle may then be passed around the arteria innominata, directing it from below upwards and inwards, and keeping it close to the vessel, to avoid the right pleura, the cardiac nerves, and the trachea. The

ligature should be applied as high as possible, in order to leave room between it and the aorta, for the formation of an internal coagulum. This formidable operation has been twice* performed, and though unsuccessfully, yet the fact has been established, that the circulation in the arm, shoulder, and neck, can be perfectly maintained after the obliteration of the trunk. This fact may encourage the surgeon to have recourse to this operation, whenever the urgency of the case may require it. Some writers have suggested a plan of performing this operation, which, however, does not present any thing to recommend it, namely, to lay bare the upper piece of the sternum, and trepan this bone, and apply the ligature near the root of the artery, and below the left vena innominata.

ARTERIÆ CAROTIDES COMMUNES.

THE student may now proceed to the dissection of the carotid arteries. The subject being laid on the back, in a horizontal posture, or with the shoulders slightly raised from the table, an incision may be made through the integuments, platisma and fascia, from the sternum to the chin, and another incision from the chin to the cartilage of the ear; the integuments should then be dissected from the muscles, and

* This artery was, I believe, first tied by Dr. Mott of New York, in the year 1815, the patient lived 26 days.

In 1822, it was performed by M. Graefe of Berlin, the patient survived 30 days.

thrown backwards. The sterno-mastoid muscle is then exposed, its sternal portion should be detached from the bone; and the sterno-hyoid and thyroid muscles being drawn inwards towards the trachea, the sheath of the carotid artery and jugular vein is exposed. The young student should make this important dissection neatly and slowly, first dissecting off the skin, then the platisma; and, before removing the fascia, he should observe its connexions,—inferiorly, to the interclavicular ligament, and superiorly, to the angle of the jaw, stylo-maxillary ligament, parotid gland, and cartilage of the ear; also, its processes, which are sent under the different muscles, and which thus connect it, in some places, to the sheath of the vessels. The muscles, superficial nerves, and veins, also may be neatly dissected, at least on one side of the neck; while on the opposite the student may repeat the same dissection, or practise the operation of tying the artery in different situations, and then make a careful dissection of the surrounding parts.

The right and left carotid arteries resemble each other so closely in their course and termination, that one description may apply to both. The only important difference is, as to their origin; the right, arising from the arteria innominata opposite the sternal end of the clavicle, is consequently shorter than the left, which proceeds from the arch of the aorta. The former is generally larger, and placed somewhat more anterior in the neck, and closer to the trachea; these vessels, diverging and inclining backwards, as-

cend as high as the superior edge of the thyroid cartilage, or the os hyoides, opposite which they divide into the internal and external carotid arteries.

The left carotid, at its origin, is covered by the sternum, the vena innominata, and a part of the remains of the thymus gland, and is about an inch and a half from the surface; after this, both carotids are covered by the integuments, platisma myoides, sterno-mastoid, sterno-hyoid, sterno-thyroid, and omo-hyoid muscles, as high as the cricoid cartilage, opposite which these muscles separating from each other, (the sterno-mastoid inclining backwards, and the others forwards), leave the artery very superficial, nothing but the integuments, platisma, fascia, and a few superficial veins and nerves, covering it from this point to its termination. The interval between the two carotids is very trifling at the lower, but at the upper part of the neck they are separated by the larynx, pharynx, and œsophagus, and by the thyroid body, the lobes of which somewhat overlap these vessels. The right carotid, as it ascends in this manner, lies over the inferior thyroid artery,* the recurrent and sympathetic nerves, the longus colli, and rectus capitis anticus major muscles. The left carotid, at its origin, lies on the trachea, immediately afterwards on the thoracic duct and œsophagus, but above this, it is similarly circumstanced with the right. About the middle of the neck these vessels lie very near the vertebræ, and, during life, may be

* In some rare instances this artery passes in front of the carotid.

compressed against these bones, in case of violent hæmorrhage from any large branch. This pressure may be effectual for a short time, but it is attended with very severe pain, and cannot be long continued. Each carotid is invested with a dense cellular tissue, called the sheath of the cervical vessels, on the anterior surface of which the descendens noni nerve is generally placed; it is closely connected to the sheath, and about the middle of the neck forms a plexus with some branches from the second and third cervical nerves; it lies, on the outside, at the upper, and on the inner side of the sheath, at the lower part of the neck. I have often found it in the sheath behind the jugular vein. In addition to the artery, this sheath contains the internal jugular vein, and par vagum, or pneumogastric nerve; the former is most external, the latter is between the vein and artery; if the former be moderately distended, it will be seen of much greater size than the latter, and will partly conceal it. On the left side, the vein is much closer to the artery at the lower part of the neck, than on the right: this depends on the different course of the right and left venæ innominatæ. Behind the sheath, are the sympathetic and cardiac nerves; a chain of conglobate glands lie along the great vessels of the neck, principally on their external side, and partly concealed by the sterno-mastoid muscle. These are also bound down by the cervical fascia, which adheres closely to the sheath, particularly below the angle of the jaw. These glands are proportionally large, and numerous; in the young subject they are frequently enlarged, and indurated

by chronic inflammation; the muscles and fascia press them closely to the vessels; they become fixed, and have a pulsation communicated to them, so as to resemble aneurism: a careful examination, however, the muscles being previously put into a relaxed position, will, in almost every case, enable the surgeon to distinguish.

Opposite the upper edge of the thyroid cartilage, or frequently opposite the cornu of the os hyoides, each carotid artery divides into two branches; one may be named the external carotid, or carotis superficialis; the other, which is the larger branch, the internal, or carotis profunda; these names being applied, not from their relative situation, but from their destination. The exact point of this division is not regular, but is generally on a level with the inferior edge of the third cervical vertebra.* The internal carotid, which is to supply the brain, lies deeper in the neck, and farther back than the superficial carotid, which is destined to the superficial parts of the head, face, &c. If the head be depressed, or the mouth opened, this division is sheltered by the angle of the jaw; but if the head be in the horizontal posture, it is nearly one inch below the level of this bony projection; and if the head be inclined backwards, the dis-

* Sometimes the carotid itself gives off the different branches of the external, and continues its course as the internal carotid. It sometimes divides near the styloid process, and sometimes so low as the cricoid cartilage: I have known two examples of the internal and external carotids, arising on one side, separately from the aorta.

tance is proportionally increased. In very young children the angle of the jaw is very obtuse, and does not descend so low as in the adult; the division of the carotid is therefore at a greater distance at this age, from this point of bone, than in the adult. In the old edentulous subject, the jaw appears drawn forward, so that the distance between its angle and the division of the carotid artery is increased. The anatomy of the vessels and nerves about the angle of the jaw should be studied in subjects of different ages; the space between this bone and the ear is greater, in proportion in the young subject, than in the adult; and again, in the edentulous subject, from a very different cause, this region is increased. Some of the primary branches of the external carotid are found, in the adult, to be very tortuous, and almost entirely concealed by the side and angle of the jaw; while, in the earlier and later periods of life, they appear more superficial, and can be much more easily exposed.

Before we enter on the particular description of the branches of the external carotid, the student should consider in what situation the common carotid artery may be most easily exposed in the living subject, for the purpose of passing a ligature around it, in any part of its course, if required by disease or accident; and to impress on his mind the exact relation of the several important parts which he may expect to meet in the operation, and which he should carefully protect from injury. Numerous observations prove, that the carotid artery may be obliterated by disease, or successfully tied without injury to the brain. The

operation of tying this artery may be required for the cure of aneurism, or in case of wound of any of its primary branches, or of aneurism by anastomosis of the vessels of the face or orbit.

From the dissection which the student has now made, he may perceive that in the upper and lower regions of the neck, this artery is very differently circumstanced with regard to the parts that cover it. From the clavicle to the cricoid cartilage it is covered by three layers of muscles, and by a considerable quantity of cellular membrane, which lies beneath the sterno-mastoid, and in which are some large veins and small arteries. In this part of the neck, the artery is at a great depth from the surface, particularly during life, when the sterno-mastoid muscle, by its contraction, raises the integuments and fascia, so as to give the appearance of a deep cavity behind it; on the contrary, when we look at the dissection in the upper part of the neck, the artery appears much more superficial, being only covered by the general investment of the neck, from the upper edge of the cricoid cartilage, as far as the digastric muscle. Even here, however, the artery is by no means so near the surface, during life, as might be inferred from a view of it when dissected, for then the integuments were borne off the sheath of the vessel, by the prominence of the larynx before, by the mastoid muscle externally, and by the side and angle of the jaw above; so that when an incision is made into this region, in the living subject, the artery appears at some depth from the surface, in a sort of axilla, in which are some

small arteries, and several veins, ascending from the thyroid gland to anastomose with the jugular and facial veins. These veins descend along the inner edge of the mastoid muscle, towards the sternum, then bend outwards beneath this last named muscle, and join either the subclavian, or some veins coming to this trunk from the shoulder.

The carotid artery may be exposed in two situations in the neck, either above the omo-hyoid muscle, or below it; in the former situation, the operation is attended with much less difficulty than in the latter, and may be selected in cases of wounds or aneurism of any of the large branches of the carotid, or in aneurism by anastomosis; but the latter must generally be selected in aneurism of the trunk of this artery.

The high operation on the carotid may be performed, in the living subject, in the following manner:—the neck being extended as far as circumstances will permit, make an incision about three inches long, at the side of the os hyoides and larynx, commencing a little below the angle of the jaw, and continuing it as low as the side of the cricoid cartilage; this incision is to divide the integuments and platisma myoides. The fascia of the neck is here very strong, and must next be divided in the same direction; it adheres to the sheath of the vessels, and to the veins which form a sort of plexus in this situation; the director, therefore, ought to be carefully insinuated beneath it, through a small opening made by the knife held in a horizontal direction; on this the fascia may be cut

safely to any extent. The operator should now proceed with great caution among several small veins that generally appear beneath this membrane;* his assistant should gently separate the edges of the wound by means of a pair of broad retractors, and the surgeon, with the blunt end of a director, can detach the cellular connexion of these superficial vessels to the sheath. The descendens noni nerve usually lies to the outside of the artery in this situation, and is not endangered in opening the sheath; its exact position, however, is very irregular. The sheath of the vessels is next to be opened, by raising a small portion of it over the artery, in a forceps, and dividing it by cautious touches of the knife held with its surface towards the vessels. This opening being enlarged, the internal jugular vein will appear distending itself occasionally, so as nearly to conceal the artery; and the surgeon, or assistant, having gently pressed this vein, and the vagus nerve, which is attached to it, towards the mastoid muscle, the blunt aneurism needle may be passed round the artery, taking care to direct it from without inwards, and to keep the end of the instrument close to the vessel, so as to avoid the sympathetic nerve, and some of its cardiac branches, particularly the superficialis cordis, which lies internal to the artery and close to it sheath. As the end of the needle is made to appear on the laryngeal side of the artery, it is covered by some cellular membrane, which it has pushed before it; by dividing this on the point of the

* See note to the description of the subclavian artery.

needle, the further course of the ligature round the artery is facilitated. Before he ties the vessel, the surgeon should carefully examine whether any nerve has been included; if so, he had better withdraw the ligature, and again pass round the aneurism needle close to the artery. The ligature being tied, one end of it may be cut off, and the other placed between the edges of the wound, opposite its attachment to the artery; the integuments should then be gently closed with adhesive plaster, and the patient, when placed in bed, should lie with the head well supported, so as to relax the muscles and vessels of the neck.

The operation may be performed in the inferior region of the neck in the following manner:—the head and neck being somewhat flexed, so as to relax the sterno-mastoid, hyoid, and thyroid muscles, make an incision about three inches in length, parallel to the inner edge of the mastoid muscle, commencing opposite the cricoid cartilage, and terminating at a little distance above the sternal end of the clavicle; by this incision, the integuments, platisma, and superficial fascia, are to be divided; the edge of the mastoid muscle will be then exposed, and close to this a very considerable vein is generally situated, to which I before alluded when describing the higher operation on the carotid artery. The sterno-mastoid muscle and this vein are to be drawn outwards; and the sterno-hyoid and thyroid muscles inwards; the omo-hyoid muscle will now be seen crossing the neck near the upper extremity of the wound; this muscle is connected to the sheath of the vessels by the deep cervical

fascia, which in this situation is thin, but strong; by carefully dividing this membrane below the omo-hyoid muscle, the sheath of the vessels will be exposed, the descendens noni nerve is here inclining to the tracheal side of the artery, and may be drawn in that direction with the sterno-thyroid muscle, in some cases it may be necessary to divide the omo-hyoid muscle; the sheath must now be opened in the same cautious manner as was before recommended. The jugular vein, by its sudden and irregular distension in the living subject, has been found to embarrass the operator, not only by nearly concealing the artery, but also by itself being in great danger of being wounded in opening the sheath; an assistant ought, therefore, to make gentle pressure on this vessel, both at the upper and lower part of the wound, for it becomes distended in both these directions, from below by the regurgitation of blood from the right auricle of the heart, and from above by that fluid descending from the head and neck; the vein and par vagum being then pressed to the outer side, and the muscles held apart by an assistant, the aneurism needle is to be cautiously pushed round the artery from without inwards, care being taken to avoid the inferior thyroid artery, the recurrent and sympathetic nerves which lie behind the sheath; and, if operating on the left side, to remember the proximity of the œsophagus internally, and of the thoracic duct posteriorly and externally. With the view to facilitate the discharge of any pus that may be collected about the ligature, some have advised this operation to be performed in the following

manner; make the superficial incisions external to those last dissected, so as to expose the cellular separation between the two heads of the sterno-mastoid muscle, and then dissect down to the artery without dividing any muscle. This place does not appear to me, to be preferable on any account to that last described.

We may here remark an important difference in the relation of the internal jugular vein, to the carotid artery in the lower part of the neck, on the right and left sides, depending on the different course of the right and left venæ innominatæ. The left jugular vein lies on a plane anterior to that of the right side, and somewhat overlaps the left carotid artery, in order to join the left vena innominata, which crosses the upper orifice of the thorax anterior to the three great arteries emerging from that cavity; whereas the jugular vein of the right side inclines outwards and backwards, to meet the right subclavian vein; the confluence of these forming the right vena innominata, which vein descends almost perpendicularly into the cavity of the chest.

The student may next proceed to dissect the branches of the carotid artery; and first, the external carotid and its ramifications.

ARTERIA CAROTIS EXTERNA, VEL SUPERFICIALIS.

This artery is somewhat smaller than the internal carotid; it lies more superficial, and is nearer to the os hyoides; its course is first upwards, inwards, and forwards, towards the submaxillary gland, but it soon inclines backwards, and ascends in a direction paral-

lel to the ramus of the lower jaw, between it and the meatus auditorius; and nearly midway between the zygomatic process and the angle of the jaw, but a little nearer to the former, it divides into the temporal and internal maxillary arteries, in the substance of the parotid gland. The external carotid artery is somewhat curved, the convexity directed inwards towards the pharynx and tonsil, the concavity outwards towards the mastoid muscle; in the lower part of its course it is covered only by the skin, platisma, the fascia, and some veins; opposite the os-hyoides it is crossed by the lingual nerve, digastric and stylo-hyoid muscles, and immediately above these it enters the parotid gland, lying very deep in the substance of that gland at its lower part, but approaching its surface as it ascends. About the centre of the parotid the portio dura or facial nerve passes over the artery, separated from it by a small portion of the gland, and by one or two large veins, the latter, however, are occasionally found superficial to the nerve. The external carotid in this course is not at first firmly supported, it merely rests on the laryngeal nerve, and pharyngeal plexus, and some cellular membrane which connects it to the internal carotid, and to the side of the pharynx. Near the angle of the jaw the stylo-pharyngeus and stylo-glossus muscles lie behind this artery, which muscles, together with a portion of the parotid gland, and glosso-pharyngeal nerve, separate the external from the internal carotid artery. The external carotid is accompanied by two veins, one on either side; at its commencement in the neck, a number of these vessels, anastomosing with the internal jugular

vein, form a sort of plexus around it, and at its termination also in the gland, it is concealed by the confluence of the temporal, transverse facial, and internal maxillary veins. The external carotid and its branches are surrounded by numerous nerves, from the sympathetic.

From the view which the student now has of this artery, it must be plain that it can be exposed in the living subject, and tied near its origin without endangering any important part, or without obstructing the internal carotid. An incision made in the same direction and to the same extent, as was recommended in the description of the high operation on the common carotid, will enable a surgeon to expose this vessel below the digastric muscle, so as to pass a ligature around it; this might be necessary in operations about the upper part of the neck, such as the extirpation of tumours about the angle of the jaw, &c. This artery also may be tied above the digastric, between it and the parotid gland, by an incision through the integuments and fascia from the lobe of the ear to the cornu of the os hyoides; the digastric and stylo-hyoid muscles will be seen passing across the artery near the inferior end of the wound, and then, by depressing these muscles, and separating them with the handle of the knife from the parotid gland, the external carotid will be brought into view, and a ligature can be passed around it. If, however, it be true that the adhesive inflammation cannot take place in any artery unless an internal coagulum of blood be formed, (an assertion which admits of doubt,) and if this cannot occur when

a large artery proceeds from the trunk near the situation of the ligature, then we cannot expect much success from the operation of tying the external carotid, as the ligature must be applied very close to the common carotid, in order to avoid the thyroid or other primary branches, if we wish to tie it before it gives off any; I have, however, seen this operation performed a few years since, and no secondary hæmorrhage ensued.

The external carotid sends off ten branches, which supply the several parts near which it passes; these may be divided into three sets or orders, the anterior, posterior, and ascending; the anterior branches are, the thyroid, lingual, and labial; the posterior are, the muscular, occipital, and posterior auris; the ascending are, the pharyngeal, transversalis faciei, internal maxillary, and temporal. This arrangement is, no doubt, open to several objections; I trust, however, it may serve to direct the pupil in his progress. I must apprise him, however, that he is not to expect to find the branches of the external carotid, in the different subjects he may dissect, uniform in their number, origin, or course; on the contrary, many varieties are met with; sometimes almost all the branches arise nearly together, so that the external carotid appears like a short axis, dividing in a radiated manner; in other cases one trunk will give rise to two or three arteries. In others, several small vessels, arising from different sources, supply the place of some particular artery; sometimes the common carotid gives origin to some of the proper branches of the

external carotid; and sometimes the common carotid will continue without any division as the internal carotid giving off in its course the required branches to the larynx, tongue, face, &c. The frequent irregularities of these arteries have induced me to coincide with Dr. Barclay in rejecting, as useless and unscientific, the classification of them that has been adopted by the editor and continuator of Bichat's Anatomy, namely, first, those that supply the organs of voice and respiration; secondly, those that are ramified on the primary organs of digestion; thirdly, those that supply the superficial parts, and the deep cavities of the face; and, fourthly, those that are ramified on the parietes of the cranium.

The student may now proceed to trace the branches of the external carotid artery nearly in the order in which they have been first mentioned.

I.

ARTERIA THYROIDEA SUPERIOR, VEL DESCENDENS,

Is the first branch of the external carotid artery; it generally arises opposite the cornu of the os hyoides, but sometimes lower down: I have found it in five or six instances arising from the common carotid. It runs upwards and inwards, then bends downwards towards the thyroid gland, in an arched but tortuous manner, convex superiorly. It soon divides into several branches, which pass beneath the different muscles

of the larynx; but the trunk is at first superficial; the lingual nerve lies superior, and the laryngeal nerve posterior to it. Its branches are usually considered as four in number.

1. RAMUS HYOIDEUS, is very small and irregular, passes along the inferior border of the os hyoides, supplies the cellular membrane between this bone and the thyroid cartilage, and anastomoses with the similar branch from the opposite side; it lies under the thyro-hyoid muscle.

2. RAMUS SUPERFICIALIS runs downwards and outwards over the sheath of the carotid artery, and is distributed to the glands, cellular membrane, and sterno-mastoid muscle.

3. RAMUS LARYNGEUS is larger than either of the last-mentioned. It often arises from the external carotid; it accompanies the laryngeal nerve, runs downwards and inwards behind the thyro-hyoid muscle, enters the larynx, either by an opening in the thyroid cartilage, or between this and the os hyoides, or sometimes between the thyroid and cricoid cartilages. It first sends a small branch superficially, which may generally be seen on the crico-thyroid ligament, in the situation in which laryngotomy is performed, this branch frequently arises from the trunk of the artery, or from one of its thyroid branches; it is then ramified on the muscles and lining membrane of the larynx and epiglottis, and anastomoses with the corresponding branches from the opposite side.

4. RAMUS THYROIDEUS is the largest branch, and the continuation of the original trunk. It de-

scends tortuously beneath the sterno-thyroid muscle, along the side and anterior surface of the thyroid body, into the parenchyma of which numerous branches penetrate, and in which some unite with the opposite artery, others descend both on the surface of this body, and between it and the wall of the larynx, to meet the inferior thyroid from the subclavian; and a small branch generally passes in a serpentine course along the anterior part of the gland, and meets in a reversed arch a similar branch from the opposite side. The thyroid artery, or its branches, are often divided by accident, as also in those wounds that are made by the ineffectual efforts of the suicide, who, in attempting to divide the larynx, seldom cuts sufficiently deep to injure the carotid artery; but very generally wounds the branches of the thyroid. Should this artery be divided, the surgeon may easily secure it; or if hæmorrhage proceed from its branches, its trunk may be exposed by making an incision through the integuments and fascia, from the os hyoides obliquely downwards, and outwards towards the mastoid muscle; some small veins only will conceal the artery. The operation of tying this vessel has been recommended in some cases of bronchocele, in which the thyroid arteries have been enlarged; for, depriving the gland of its usual supply of blood has been found in some instances to retard its further growth. In many individuals the superior thyroid artery of one or both sides will be found very small; in such, the inferior thyroid arteries will be proportionably large, and *vice versa*.

II.

ARTERIA LINGUALIS,

Arises at a little distance above the thyroid and below the labial. I should, however, advise the dissector to trace the labial artery and its branches, before those of the lingual, contrary to the order in which they are here described. Both arteries frequently arise from a common trunk. The lingual runs at first horizontally inwards and forwards towards the os hyoides, and passing above the cornu of that bone, rises vertically to the inferior surface of the tongue; and, lastly, it runs horizontally forwards to the anterior extremity of this organ. Thus, it forms two remarkable curvatures, which enable us to divide it into three portions, the first and last of which are horizontal, the middle is vertical. The first or cervical portion extends from the carotid to the cornu of the os hyoides, it forms an arch convex upwards, and parallel to that of the thyroid artery, the cornu of the os hyoides moves between these two; this portion of the artery is covered only by the common integuments, platisma, and fascia of the neck, some anastomosing veins and lymphatic glands, the lingual or ninth nerve is also superficial, but superior to it; it lies upon the superior laryngeal nerve, and a quantity of loose cellular membrane. The second or vertical portion lies deep in the neck, and extends from the os hyoides, between the muscles of the tongue, to the

fore part of the root of this organ. In this part of its course, it is covered by the digastric tendon, by the hyo-glossus and mylo-hyoid muscles, and is placed on the middle constrictor of the pharynx, and on the external side of the genio-glossus muscle, between this and the hyo-glossus muscle and the sublingual gland; the lingual nerve is separated in this part of its course from the artery, by the hyo-glossus muscle, the nerve being placed on the inferior or superficial, the artery on the superior or deep surface of that muscle; but at its anterior edge the nerve and artery again approximate, and their ultimate branches are distributed together to the tongue. The third or last portion of the artery is contained in the mouth, and runs horizontally on the under surface of the tongue, close to the frænum as far as its point, where it anastomoses by an arch with that from the other side; it is very superficial, being only covered by the mucous membrane, a vein, and some filaments from the lingual and gustatory nerves. The principal branches of the lingual artery are four.

1. Ramus hyodeus arises at the external edge of the hyo-glossus muscle, and runs to the os hyoides beneath the digastric tendon, where it divides into several branches; these are distributed to the muscles that are attached to this bone, and to the epiglottidean gland, and anastomose with branches from the thyroid artery, and with some from the opposite side.

2. Arteria dorsalis linguæ arises from the lingual artery, while it is covered by the hyo-glossus muscle; it first runs outwards to the side of the

tongue, and then turns upwards and inwards to the superior surface of this organ, and anastomoses with its fellow from the opposite side, having first given branches to the stylo-glossus muscle, to the tonsil, to the arches of the palate, and to the mucous membrane of the fauces and epiglottis; this is not a regular branch, several small arteries frequently supply its place.

3. ARTERIA SUBLINGUALIS arises at the anterior edge of the hyo-glossus muscle; here the lingual artery divides into the sublingual and ranine. The sublingual is exposed by raising the mylo-hyoid muscle, it runs forwards and outwards to the sublingual gland, supplies it and the mucous membrane of the mouth and surrounding muscles; it also sometimes sends a branch to the chin. This is also an irregular artery, it is frequently derived from the submental branch of the facial or labial, and then either perforates the mylo-hyoid muscle, or accompanies the duct of the submaxillary gland, which runs between that muscle and the sublingual gland to the frænum linguæ.

4. ARTERIA RANINA appears to be the continued trunk; it is exposed by detaching the digastric, genio-hyoid, mylo-hyoid, and genio-glossus muscles from the lower jaw, and the hyo-glossus from the os hyoides, then, by dividing the jaw at its symphisis, and drawing the tongue forwards and upwards, from the cavity of the mouth, this artery may be seen with very little dissection; it runs along the lingualis muscle on the outside of the genio-hyo-glossus, and on the inner side of the hyo-glossus and stylo-glossus

muscles and sublingual gland as far as the tip of the tongue, where the arteries of opposite sides arch towards one another, and end in a delicate anastomosis. The ranine artery supplies the muscle as well as the substance and surface of the tongue on either side; in the mouth, it lies close to the side of the frænum linguæ, and is covered only by the mucous membrane, a small vein, and a branch of the lingual nerve. The ranine arteries of opposite sides do not anastomose with each other except at the extremity of the tongue, so that the sides of this organ may be injected with different coloured fluids.

In dividing the frænum linguæ in children, (an operation not often required,) the blunt pointed scissors should be directed downwards and backwards, and thus the ranine arteries and veins will be avoided. If a wound or ulcer on the tongue be attended with severe hæmorrhage, which cannot be restrained by any local means, it has been suggested, that the trunk of the lingual artery may be exposed and tied in the neck, by making a transverse incision through the integuments and fascia from the os hyoides to the mastoid muscle; the edges of this incision being separated, we expose the tendon of the digastric muscle, and below this the lingual nerve; the lingual artery lies immediately below this, and a little posterior to it, or nearer to the vertebræ, and is partly concealed by a lymphatic gland, some veins, and cellular membrane; the superior thyroid artery is inferior to it, the laryngeal nerve is behind it, the pharynx is internal to it, and the carotid artery and jugular vein are to its outer

side; although the lingual artery is here thinly covered, yet, in the living neck, it is by no means so near the surface as might be supposed from the appearance of these parts when dissected in the dead subject; for during life, the integuments and fascia are so borne off the vessel by the surrounding projections, that when these superficial coverings are divided, the artery appears to lie at the bottom of a deep cavity; and even in the dead subject there is considerable difficulty in exposing it, without disturbing the surrounding parts to some extent. If, in addition to the depth at which this artery lies from the surface, we think of the number of important parts that are in its vicinity, and the irregularity of its origin, we cannot consider this a very advisable operation to undertake in the living subject, or one to be preferred to that of tying the external or common carotid, more particularly when we reflect on the position in which the patient must be placed in order to enable us to make the necessary dissection.

III.

ARTERIA LABIALIS, VEL FACIALIS, VEL MAXILLARIS EXTERNA,

Arises a little above the lingual, ascends obliquely inwards towards the pharynx and tonsil, runs in a very tortuous manner through the submaxillary gland, anterior to the internal pterygoid muscle and stylo-maxillary ligament; it then descends, winds

round the side of the lower jaw at the edge of the masseter muscle, then runs upwards and inwards along the cheek to the side of the nose, and ends at the inner canthus of the orbit. At its origin it is covered by the common integuments, and by the digastric and stylo-hyoid muscles, it then sinks into the posterior or external extremity of the submaxillary gland; as it passes over the side of the jaw, it is only covered by the integuments, and by a few fibres of the platisma, and triangularis oris muscles; it is here also crossed by some branches of the facial nerve, and is accompanied by a single vein of considerable size, which lies to its posterior or masseteric side. In its serpentine course on the side of the face, (in which it forms numerous turns or coils upon itself, to accommodate the motions of the parts over which it passes,) it lies buried in the fat of the cheek, which separates it from the buccinator muscle, and is crossed near the angle of the mouth by the zygomatic muscle, and by the union of the levator labii superioris, and triangularis oris muscles; the facial vein accompanies it throughout this course, and usually lies to its external side, this vessel is not tortuous as the artery is.

The branches of this artery may be arranged into those sent off before it passes the jaw, and those afterwards, or into the cervical and facial; the former are four, the latter are six in number.

1. Arteria palatina inferior arises near the carotid; it runs upwards, inwards, and backwards, between the stylo-pharyngeus and stylo-glossus muscles; it divides into several branches, some of which

are given to these muscles, others to the superior constrictor, through which several pass, along with small nerves, from the pharyngeal plexus, to the mucous membrane of the pharynx and velum palati, and to the amygdalæ, and inosculate with the descending or superior palatine from the internal maxillary artery.

2. ARTERIA TONSILARIS arises immediately above the last, ascends between the stylo-glossus and internal pterygoid muscles, to each of which it sends branches, and entering the external surface of the tonsil, ramifies through its substance, and anastomoses with the other arteries, which supply this gland, and which are derived from the last mentioned branch, and from the pharyngeal and internal maxillary. The tonsilitic and palatine arteries frequently arise from the labial by a common trunk, which will then take the course of the palatine, and will give off a distinct branch to the external side of the tonsil: in some subjects one or both of those arteries arise from the ascending pharyngeal from the carotid.

3. ARTERIÆ GLANDULARES are three or four considerable branches, which spread through the submaxillary gland, and in it, divide into very minute and numerous twigs, each of which, accompanied by a small vein, and a branch of the excretory duct, goes to one of those grains or particles, of an assemblage of which this conglomerate gland is composed. Some branches also pass to the surrounding muscles, and to the neighbouring lymphatic glands.

4. ARTERIA SUBMENTALIS arises from the labial artery, as this trunk leaves the gland, and before it

turns round the side of the jaw; it then runs towards the chin, along the inferior and internal margin of the bone, giving branches to the integuments, to the submaxillary and lymphatic glands, and to the mylo-hyoid and digastric muscles. At the anterior insertion of this latter muscle, it divides into several branches; some of these pass beneath the genio and mylo-hyoid muscles, and anastomose with the sublingual artery; others ascend on each side of the digastric; some perforate the muscle itself, turn round the chin, supply the integuments and muscles there, and then ascend to anastomose with the arteries of the lower lip, and with small branches of the dental artery, which escape through the mental foramen of the lower jaw. Several small lymphatic glands lie along the course of this artery, and are connected to it by branches which they receive from it. When any or all of these glands are enlarged, they form a firm tumour, which appears to occupy nearly the same situation as the submaxillary gland. A tumour of this nature, in this situation, may be removed without much difficulty; and such an operation has been considered as the extirpation of the submaxillary gland itself: but the removal of this body would be much more difficult than an operator might at first suppose. The labial artery and vein should, of course, be sacrificed; but the greatest difficulty, and one which cannot I think be surmounted, without doing great violence to the surrounding parts, would be, the detaching that deep process of the gland which accompanies its duct, above the mylo-hyoid muscle, and which joins the

sublingual gland, and which is also connected to the gustatory nerve and to the membrane of the mouth: the depth at which this lies from the surface, the proximity of the gustatory and lingual nerves, as well as of the carotid artery and its branches, and the manner in which the mylo-hyoid muscle protects this deep process, must render such an operation extremely difficult and dangerous.

As the labial pursues its serpentine course, it gives several facial branches to either side, the most important of these are the following:—

5. ARTERIA LABIALIS INFERIOR runs to the integuments and muscles of the lower lip, and anastomoses with the dental and and submental arteries, and with the corresponding branch from the opposite side.

6. ARTERIA CORONARIA INFERIOR passes upwards and inwards, is partly covered by the triangularis oris, runs close to the mucous membrane of the lip, and beneath the orbicularis oris muscle, supplies this vascular part, by a complex network of vessels, and meets the artery from the opposite side; it also anastomoses with the inferior labial and dental arteries. Inferior to this artery, are a number of those small, round, mucous glands, called labial, which are furnished with long, delicate branches from the coronary arteries; in one or other of these glands the disease of cancer frequently commences, and may proceed to some extent in this structure before the integuments become affected. The lymphatic glands about the submaxillary, are frequently enlarged in

this species of the disease, before the skin or mucous membrane ulcerates. In one case, in the extirpation of which I lately assisted, a lymphatic vessel was distinctly felt leading from this part towards one of the glands beneath the jaw; the coats of this vessel were very much thickened and indurated, so as to resemble the feel of the vas deferens: the labial glands are larger and more numerous in the lower than in the upper lip.

7. ARTERIÆ MASSETERICÆ arise from the external side of the labial, run outwards to the masseter and buccinator muscles, send branches to each of these, and anastomose with the temporal, transversalis faciei, and internal maxillary arteries.

8. ARTERIA CORONARIA SUPERIOR runs very tortuously to the upper lip, lies close to its mucous surface, and, like the inferior coronary, is distributed to its red border, and joins the corresponding artery from the opposite side; from this anastomosis, branches ascend to the nose, which supply the extremity of this organ, and some of these entering its cavity, inosculate on its mucous membrane with the proper nasal arteries.

9. ARTERIA NASI LATERALIS arises from the labial, as this vessel is ascending on the levator labii superioris alæque nasi; it is, in general, a small and irregular artery; it spreads its branches on the side of the nose, and anastomoses with its fellow, and with branches descending from the forehead.

10. ARTERIA ANGULARIS is the last branch of the labial; it ascends between the origins of the leva-

tor labii superioris alæque nasi, to the inner angle of the orbit; is accompanied by a large vein, sends branches outwards to the cheek and inferior palpebra; these anastomose with the infraorbital artery. The angular artery then gives branches to the lachrymal sac and orbicularis muscle, and terminates in a free anastomosis with the nasal and frontal branches of the ophthalmic artery.

The labial or facial arteries have numerous inosculations on the face, not only with one another, but with arteries from distant sources; inferiorly, they anastomose with the dental; externally, towards the masseter muscle, they inosculate freely and repeatedly with the transverse arteries of the face, with the temporal, with muscular branches from the internal maxillary, and with the infra orbital; and, superiorly, with the frontal and ophthalmic arteries, which are derived from the internal carotid.

As the facial arteries are passing over the side of the jaw, they can be very easily exposed by an incision made nearly parallel to the anterior edge of the masseter muscle, for the purpose of having a ligature passed around them; they can be also effectually compressed in this situation against the bone; this is usually done in operations on the lips, to obviate the inconvenience of hæmorrhage. Although this is a very general practice, yet it is seldom of much efficacy, for the several inosculations carry the blood to the coronary arteries, as abundantly as if the labial vessels were free. A more effectual method of preventing hæmorrhage is, for the assistant to press the

lip between his finger and thumb on one side of the part to be excised, while the surgeon, between the fingers of his left hand, compresses the lip on the opposite side.* The coronary arteries are always close to the mucous membrane of the lips, and, during life, can be felt pulsating on the inner surface of their red border. Blows or falls, by forcing the lip against the teeth, sometimes wound these vessels, and cause very copious bleeding; in such cases the surgeon need only evert the lip, and secure the vessel by the tenaculum and ligature, or with a single stitch, without injuring the integuments.

When the lip has been divided, either for the removal of hare-lip, or of a diseased portion, and that the edges are to be closed by suture, care should be taken to pass the needle nearly through the red border on each side. If the edges be closed only on the cutaneous surface, the coronary arteries will bleed into the mouth, in consequence of the internal edges of the wound retracting, and the hæmorrhage will require the surgeon to re-open the part, and pass the suture through the substance of the lip.

As the angular vein and artery lie near the edge of the orbit, the surgeon, in order to avoid injuring them in opening the lachrymal sac, in cases of fistula lachrymalis, should cut to their external side.

The second set, or order of branches, is the poste-

* There are neat small tourniquets constructed for this purpose, which screw on the angles of the mouth, and command these arteries effectually.

rior, of which we generally see three, the muscularis, occipitalis, and posterior auris.

IV.

ARTERIA STERNO-MASTOIDEA, VEL MUSCULARIS.

This artery, though not generally described by anatomical writers, yet is so frequently present, that I think it may be considered as one of the regular posterior branches. Its origin is not uniform; it generally arises from the external carotid, opposite to the origin of the thyroid; but it sometimes comes from the thyroid itself, or from the occipital, and I have seen it arising from the common carotid, a little before the division of that trunk. From its origin this artery inclines downwards and outwards to the sterno-mastoid muscle, supplies the lymphatic glands in its course, and then divides into several branches, most of which enter that muscle. A large one generally accompanies the spinal accessory nerve through the muscle, and anastomoses with some of the cervical branches of the subclavian, between the trapezius and sterno-mastoid muscles. In the last named muscle they also inosculate with branches from the occipital, thyroid, and subclavian arteries. This artery also sends branches to the deep muscles on the anterior part of the neck, the scaleni, and rectus capitis anticus major; these also inosculate with arteries from the subclavian.

V.

ARTERIA OCCIPITALIS,

Arises from the outside of the external carotid, at the lower margin of the digastric muscle, opposite the lingual or labial artery, but is smaller than either of these vessels; it runs upwards and backwards, parallel to, and concealed by the posterior belly of the digastric, passes above the transverse process of the atlas, and is buried in a groove in the temporal bone on the inside of its mastoid process, it then runs horizontally backwards on the occipital bone, parallel to the transverse ridge of that bone, near the centre of which it rises vertically, and divides into wide spreading branches on the back of the cranium. The occipital artery at its origin has the ninth pair of nerves passing round it, and is concealed by the stylo-hyoid, and digastric muscles, by part of the parotid gland, and superiorly and posteriorly to these, by the sterno-mastoid, the trachelo-mastoideus, splenius capitis, complexus, and trapezius muscles, and ultimately, it is covered only by the scalp; the artery at first passes over the internal carotid, jugular vein, par vagum, and spinal accessory nerves, it then lies on the rectus capitis lateralis; as it inclines backwards beneath the complexus, it crosses the superior attachment of the posterior recti and obliqui muscles, and terminates on the occipital bone. The occipital artery soon after its origin gives small branches to the

mastoid muscle, lymphatic glands, and parotid; as it crosses the jugular vein, it sends a small branch upwards along this vessel, named the posterior meningeal artery, this branch enters the cranium by the foramen lacerum posterius, and supplies the dura mater in the inferior and posterior part of the cranium. As the occipital artery passes above the atlas, it gives off several short branches, some of which anastomose with the vertebral artery, and others supply the small deep-seated muscles on the back of the neck; while the occipital is covered by the trapezius and complexus, it sends down several long and tortuous branches to supply the muscles in this region; some of these lie almost close to the vertebræ, are covered by the splenius capitis and complexus, and anastomose with the vertebral and cervicalis profunda arteries, from the subclavian; others run superficially, being only covered by the trapezius, and inosculate with the arteria cervicalis superficialis, a branch from the transversalis colli.

In a well injected subject, these arteries are found large and numerous, and keep up a free connexion with the arteries about the shoulder; a connexion that must be of essential service in conducting the blood to the superior extremity in cases of obliteration of the subclavian artery, in consequence of operation or disease; as the occipital artery ascends on the back of the cranium, it is accompanied by a large nerve, (the posterior branch of the second cervical,) both perforate the tendinous attachment of the trapezius muscle to the occipital bone, and divide into numerous ramifica-

tions. Some small and delicate arteries go to the posterior belly of the occipito frontalis muscle: one or two pierce the occipital, or the temporal bone, and supply the dura mater; others, and the principal branches, spread out in the scalp in all directions; they are wonderfully tortuous, particularly in old subjects; all these branches divide in the integuments with the greatest minuteness, and anastomose with the ultimate divisions of the opposite occipital, and with those of the posterior auris, and posterior temporal arteries.

Hæmorrhage from the branches of this artery in wounds of the scalp is very common, it is, however, in most cases easily restrained by pressure at the part; the trunk of the artery can be exposed about an inch behind the mastoid process, by dividing a portion of the trapezius and splenius capitis muscles, the peculiar density of the surrounding cellular tissue and the great size of the veins, render the dissection difficult.

VI.

ARTERIA POSTERIOR AURIS,

Is one of the smallest and most irregular branches of the external carotid; it very often arises from the occipital; in some subjects a few small branches from this artery appear to supply its place; when regular, it arises from the external carotid above the digastric and stylo-hyoid muscles, opposite the point of the styloid process, and is partly concealed by the parotid

gland, in the posterior part of which it is imbedded; it runs upwards and backwards between the ear and mastoid process, then ascends on the temporal bone, and divides into two branches; the anterior branch becomes attached to the posterior part of the cartilage of the ear, on which it ramifies minutely; the posterior ascends on the side of the cranium, supplies the back part of the temporal muscle, the integuments, &c., and anastomoses with the temporal and occipital arteries; in this course the posterior auris gives off small branches to the digastric, stylo-hyoid, and mastoid muscles, and also to the parotid gland: as it approaches the mastoid process, it lies behind the portia dura, and there separates this nerve from the spinal accessory. The posterior auris sends off a delicate branch, which enters the stylo-mastoid foramen, ramifies throughout the temporal bone, supplying the tympanum, mastoid cells, semicircular canals, &c., and anastomoses with other arteries which the organ of hearing receives from branches of the meningeal and basilar arteries.

The branches of the posterior auris sometimes increase in number and size, so as to give rise to the disease of aneurism, by anastomosis in the figured portion of the ear; in this disease there is considerable swelling, pain, and redness, with a sensation of great throbbing in the part: in one case of this disease, I saw the operation performed of tying this artery in front of the mastoid process, but with very little effect; the progress of the disease was suspended

only for a few days, the pain and tension were relieved during that short period, after which all the symptoms returned, and the disease continued unabated.

In dissecting this artery and its branches, the student should observe the situation and course of the portio dura, or facial nerve, the distance of the stylo-mastoid foramen from the surface, and the manner in which the nerve, immediately on escaping from this opening, bends forwards and enters the parotid gland. In those cases of tic douloureux, in which pain and spasm extend in the course of this nerve or of its branches, it has been recommended to remove a portion of it before it enters the parotid gland; this operation is attended with considerable difficulty, owing to the projection of the mastoid process, and to the depth of the stylo-mastoid foramen from the surface; the parotid gland also must be injured; the superficialis colli nerve will, most probably, be divided as well as the posterior auris artery and some of the branches of the occipital; these vessels will pour their blood into the deep cavity around, and thus obscure the view of the nerve. I have found this nerve to give off some branches immediately on leaving the foramen; these join the eighth pair of nerves and the sympathetic, so near the base of the cranium, that I think it scarcely possible, in the adult subject, to remove a portion of it before it has given off these deep branches, without making a more free dissection of the surrounding parts than could be considered safe or judicious. In the child, this dissection will be found

much less difficult, in consequence of the slight projection of the mastoid process, and the shortness of the meatus auditorius externus, the stylo-mastoid foramen is consequently much nearer to the surface, neither is the parotid gland so closely connected to the mastoid process in the young, as it is in the adult subject.

The third order of branches from the external carotid artery, is the ascending, which may be considered as four in number; namely, the pharyngea ascendens, the transversalis faciei, the temporalis and maxillaris interna. The two latter may be considered as terminating the external carotid, and some consider the transversalis faciei as a branch only from the temporal.

VII.

ARTERIA PHARYNGEA ASCENDENS,

Is smaller than the posterior auris; it lies very deep, being concealed by the external carotid artery and its branches, and also by the stylo-pharyngeus and the pterygoid muscles. It arises from the posterior part of the external carotid, near the division of the common carotid, and ascends to the base of the cranium, between the pharynx and the internal carotid. In order to obtain a satisfactory view of the course and termination of this artery, the student should cut across the labial and lingual arteries; then, drawing the external carotid outwards, towards the mastoid muscle, the pharyngeal artery may be seen ascending

along the side of the pharynx, lying on the rectus capitis anticus major muscle, and close to the superior ganglion of the sympathetic nerve;—the small branches, however, which it sends to the base of the cranium, cannot be fully exposed without dividing the lower jaw at the symphisis, and dislocating it on one side; but this I should not advise the student to do in the present stage of the dissection, as the branches of the pharyngeal may be seen more distinctly afterwards, when he is tracing the internal carotid. As the pharyngeal artery ascends by the side of the pharynx, it gives off branches internally and externally; the former are three or four in number, two of which descend to supply the middle and inferior constrictors of the pharynx, and the stylo-pharyngeus muscle; these end in numerous and minute ramifications on the mucous membrane of the pharynx, and are completely interwoven with the pharyngeal plexus of nerves; the larger of the internal branches pass inwards to the superior constrictor; in a well injected subject, these are of considerable size, and very tortuous; many of them extend to the velum and its muscles, to the amygdalæ and arches of the palate. From the external side of the pharyngeal proceed several arteries to the sympathetic, lingual, and pneumogastric nerves, also to the anterior recti muscles; finally, when the pharyngeal artery has arrived at the base of the cranium, it becomes very tortuous, lying in a quantity of loose adipose substance, beneath the petrous bone, and rather behind the upper constrictor of the pharynx; it here sends off several branches,

some of which are still distributed to the pharynx; two or three twine around the Eustachian tube, ramify minutely on the mucous membrane, which is continued from its trumpet mouth to the posterior nares; these inosculate with the nasal arteries; others pass through the foramina in basi cranii to the dura mater; one, the posterior meningeal artery, passes backwards to the jugular vein, and enters the cranium by the posterior lacerated opening; one ascends directly from the Eustachian tube, and perforates the cartilage that fills up the space between the petrous bone and body of the sphenoid, a space which, in the dry skull, is named foramen lacerum anterius basis cranii: a small branch also passes through the lingual foramen of the occipital bone. All these arteries serve the double purpose of supplying the bones with their nutritious vessels, and nourishing the dura mater.

VIII.

ARTERIA TRANSVERSALIS FACIEI,

Is the second branch I have classed among those that ascend from the carotid, although I am aware that the irregularity of its origin ought almost to preclude it from such an arrangement; for, I believe it arises from the temporal, as frequently as from the carotid; nor does the direction of its course, as its name implies, strictly entitle it to the appellation of an ascending branch. Its proximity, however, to the temporal and internal maxillary, has induced me to arrange it

with these arteries. The transversalis faciei artery arises from the external carotid, in the parotid gland, sometimes a little above the angle, and sometimes near the neck of the jaw, runs upwards and forwards through the gland to its anterior edge, is surrounded by several filaments from the portio dura nerve; it then crosses the masseter, a little below the zygoma, and accompanies the parotid duct, lying superior to it, and partly covered by the socia parotidis. At the anterior edge of the masseter it divides into ascending and descending branches, which supply the muscles of the face, and inosculate freely with the infra orbital and labial arteries. This artery is very uncertain as to size and origin; it frequently crosses the masseter near its inferior attachment, and below the parotid duct; and sometimes there are two arteries arising distinctly, one from the carotid, the other from the temporal; both of which take a transverse direction, and terminate in a free anastomosis on the face. The transversalis faciei gives several branches to the parotid gland, and to the masseter muscle, in addition to which, that muscle receives small arteries from the carotid itself; these have been named by Portal, *arteriæ masstericæ.*

IX.

ARTERIA TEMPORALIS SUPERFICIALIS.

NEAR the neck of the lower jaw, the external carotid divides into the temporal and internal maxillary ar-

teries; the latter is the larger of the two, but the former, from the direction of its course, appears as the continued trunk. For obvious reasons it is better for the student to trace this vessel to its termination before he commences the complicated dissection of the internal maxillary, with the description of which I shall conclude that of the branches of the external carotid. The temporal artery gradually emerges from the parotid gland, ascends between the meatus auditorius and the articulation of the maxilla, passes behind the root of the zygoma, and about one inch and a half above this, it divides into two principal branches, an anterior and posterior. This artery is at first concealed by part of the parotid gland; as it passes over the horizontal root of the zygomatic process, it is crossed by the small anterior muscle of the ear, and, for a little distance above this, is covered by part of the dense fascia of the parotid which adheres to the cartilage of the ear, and which is continued for some distance on the artery. In this situation two or three veins partially cover the vessel, and a lymphatic gland is also frequently attached to it; it is also accompanied by branches of the portia dura and temporo-auricular nerves: afterwards, as the temporal artery and its branches ascend on the temporal aponeurosis, they are only covered by the common integuments. As the artery passes through the parotid gland, in addition to branches to its substance, it gives off—

1. ARTERIÆ ANTERIORES AURIS, and
2. ARTERIÆ CAPSULARES: these are uncertain in

number and magnitude; the former, as their name implies, are distributed to the anterior part of the ear; the latter, to the capsular ligament of the lower jaw.

3. ARTERIA TEMPORALIS MEDIA arises from the temporal, immediately above the zygomatic arch it penetrates the temporal aponeurosis, and ramifies through the temporal muscle, in which it anastomoses with the deep temporal arteries from the internal maxillary.

4. ARTERIA TEMPORALIS POSTERIOR arches upwards and backwards, spreading its tortuous branches in all directions to supply the scalp and occipito frontalis muscle, and to anastomose with the opposite temporal, and with the posterior auris and occipital arteries.

5. ARTERIA TEMPORALIS ANTERIOR takes a contrary direction, runs in a serpentine manner upwards and forwards towards the superciliary arch; its branches are distributed to the integuments, orbicularis palpebrarum, and muscles of the forehead, and anastomose some with the supra orbital and frontal branches of the ophthalmic artery, and others bend towards the vertex, to meet similar branches from the opposite side.

The anterior branch of the temporal is usually selected for the operation of arteriotomy, in cases of inflammation of the eye, or affections of the brain. In order to open this artery effectually, the surgeon should first feel it pulsating, with two fingers of his left hand, then press these gently against the vessel, at a

little distance from each other, so as to fix it in its place, taking care, however, not to alter the relative position of the skin to the vessel, he should open it between these obliquely with the lancet. If the student examine the artery near the zygoma, he will observe that it is covered for some extent by the dense fascia of the parotid gland; this covering is a cause of considerable difficulty in suppressing hæmorrhage, when arteriotomy has been performed in this situation, and if pressure be applied sufficient to command the artery, a sloughing may ensue which will occasion a troublesome and embarrassing secondary hæmorrhage; or it may give rise to an alarming erysipelatous inflammation, bringing the life of the patient into imminent danger. I have also known other unpleasant effects produced by opening the temporal artery near the zygoma, such as severe pain both at the time of the operation and afterwards, probably from a branch of the portia dura, or of the temporo-auricular nerve having been wounded, inflammation extending to the parotid gland, or meatus auditorius, and sometimes terminating in tedious abscesses, &c. &c.; and, as the artery is here partly covered by some veins which may be wounded in the operation, a varicose aneurism may be formed, one very troublesome instance of which I have known; for these reasons, I should advise the student against the practice of indiscriminately opening the temporal artery near the zygomatic arch.

X.

ARTERIA MAXILLARIS INTERNA,

Is larger than the temporal, from which it passes off nearly at right angles to the inside of the ramus of the jaw: the dissection of this artery is difficult and confused; it may assist the student to have a dry skull and lower jaw before him, and on these first to trace the course of the artery, and gain a clear idea of the relative situation of the different processes or foramina, to which this vessel or its branches are connected. The internal maxillary is very tortuous, it runs from the ramus of the jaw, first inwards and a little downwards, then ascends, and inclines forwards, inwards, and upwards, to the posterior part of the orbit; it here descends into the pterygo-maxillary fossa, and divides into its terminating branches. In order to obtain a satisfactory view of the origin of this artery, and of the first part of its course, the student should remove the greater part of the parotid gland; in doing this, he should carefully study the different relations of this organ to the surrounding muscles, vessels, and nerves.

The parotid, like most conglomerate glands, does not possess a distinct capsule, so that its exact form or extent is not limited; it is true, it is bound down and confined to a regular situation by the strong fascia of the neck, which fascia is continued over it, and adheres posteriorly to the mastoid muscle and

process, and to the cartilage of the ear; superiorly to the zygoma, anteriorly to the masseter muscle, and inferiorly to the angle of the jaw, behind which it sends in a process to be connected to the stylo-maxillary ligament, by which the parotid is separated from the sub-maxillary gland. When this fascia is raised, the superficial extent of the parotid is exposed; it is observed to ascend as high as the zygoma, to which its superior margin is parallel; inferiorly it will rest on a line drawn from the mastoid process to the angle of the jaw, posteriorly, it is moulded on the cartilage of the ear and edge of the mastoid and digastric muscles, insinuating itself between these; anteriorly it extends over the posterior third of the masseter muscle, while a process of the gland, named socia parotidis, which lies above the duct, runs across the upper part of the masseter muscle to its anterior edge; the duct takes an arched course from the edge of the gland to the buccinator muscle, which it perforates opposite the second molar tooth of the superior maxilla; a line drawn from the meatus auditorius, to midway between the angle of the mouth, and root of the nose, nearly defines the course of this canal. I mentioned before, that the transversalis faciei artery, and socia parotidis, lie superior to it; it is accompanied by several branches of the portia dura nerve; before perforating the buccinator muscle the facial vein crosses it; the artery is nearer the angle of the mouth. Several lymphatic glands may be observed to be connected to the parotid; one or two are imbedded in it, in front of the cartilage of the ear, and opposite the

division of the external carotid artery; three or four are generally found along the inferior border of the gland and digastric muscle.

The student having studied these boundaries of the gland, may now proceed to remove it; and in doing this, he should carefully remark the great depth to which it passes, and observe its important connexion to the deep-seated muscles, nerves, and vessels. First divide the parotid duct and its accompanying arteries and nerves, and raise them, together with the anterio part of the gland, from the masseter muscle and ramus of the jaw; turning this portion of the gland backwards towards the ear, next divide the temporal vessels, and detach the gland at its superior extremity, then separate it from the cartilage of the ear, from the mastoid and digastric muscles, dividing the portia dura nerve; the circumference of the gland is thus completely loosened; and now if the student grasp it firmly with a view to twist or tear it out of its situation, he will find it very difficult to do so; he may even raise the head of the subject from the table, or break the gland, before he can dislodge it from the deep recess into which it extends itself. This is the part of the gland, the connexion of which the student is next to examine; he may observe that it fills the glenoid cavity between the capsular ligament of the jaw, and meatus auditorius; on drawing it out of this cavity, a process of the gland is seen to pass inside the ramus of the jaw, with the internal maxillary vein and artery, between the bone and internal lateral ligament, and to touch the infe-

rior maxillary nerve; this process often swells out between the two pterygoid muscles into a considerable mass, connected like a distinct lobe to the body of the gland, by the narrow neck that passes on the inside of the ramus of the bone. When this has been dissected out of its situation, and the gland drawn towards the neck, a thick portion of it is seen sinking in between the mastoid process of the temporal bone and the angle of the jaw, and resting on the styloid process, around which it is completely folded, so as to come in contact with the great vessels and nerves at the base of the cranium: to this part of the gland the student should pay particular attention; if both veins and arteries have been injected, he may perceive the proximity of the great jugular vein, as well as of the internal carotid artery; as the gland passes behind the styloid process, it touches the vein, the eighth and ninth pairs of nerves, while anterior to this process, it rests on the internal carotid artery and sympathetic nerve; this portion of the gland is also extended above the stylo-maxillary ligament, and is attached to the internal pterygoid muscle, where it enlarges very considerably; the manner in which this deep lobe of the gland is thus impacted between the styloid and mastoid processes, and again between the styloid process and the angle of the jaw, explains the difficulty of tearing it out of this situation, as some authors have advised in the operation of extirpating this gland, in cases of its enlargement and disease. Before the student proceeds with the dissection of the internal maxillary, let him again consider the nume-

rous connexions of the parotid gland, let him open the anterior or superficial lobe of it, and expose the ramifications of the facial nerve, and the branching of the external carotid, also the large veins which descend from the temple to meet the great trunk of the internal maxillary, which comes from within the ramus of the jaw; let him reflect on the serious injury that must be inflicted in attempting to remove even this part of the gland, which, however, is comparatively easy to that of the deeper portion, and which can only be accomplished with safety in the living subject, by proceeding with the greatest caution among such important parts, an injury of some of which must be almost certainly fatal. When we consider these natural impediments to the extirpation of this gland, and how these may be increased by disease, and when we take into consideration also, that malignant diseases of this gland are very rare, it is impossible not to question the correctness of many of those superficial accounts, which are written of the extirpation of this gland, as of an ordinary tumour. Within these late years, however, several* well authenticated cases have occurred in this country, and upon the continent, in which this gland has been completely and successfully extirpated, in some of these cases the hæmorrhage was very violent, in others it was very trivial, and in most paralysis of the face continued as an incurable consequence.

Although the parenchyma of the parotid gland is

* See Velpeau's Med. Operat. tom. ii. p. 173.

as very subject to [illegible] his character [illegible] issue, or in some of the [illegible] along its inferior [illegible] substance: when a [illegible] rise, its pressure will [illegible] rotid, whose [illegible] whose form it will [illegible] however, will [illegible] even when [illegible] removal, with [illegible] rotid gland [illegible] rally be found [illegible] enable the [illegible] posed and [illegible] ions, and thus to [illegible] nours too, are [illegible] or by the [illegible] are they so [illegible] nerves, and muscles in this region, as [illegible] nor as might be [illegible]

Mr. Allen Burns, in his [illegible] gical Anatomy of the [illegible] self very strongly upon this point of [illegible] his opinion, [illegible] and in some measure proved it to be [illegible] results of the more [illegible] yet still appears to me to be at variance with the [illegible] tion of the student, and [illegible] shall transcribe his words:—

"The parotid gland is [illegible]

firmly locked in between the ascending plate of the lower jaw and the mastoid process, that when it becomes diseased, the patient cannot open his mouth, and from the effect of the fascia, the tumour is flat; its extirpation is quite out of the question; its impracticability is proved by reviewing the connexions of this gland; whoever has in situ injected the gland with mercury, and then, even where it was healthy and free from preternatural adhesions, and limited to its natural size, has tried to cut it out, would be convinced, when he saw the mercury running from innumerable pores, that the gland extends into recesses into which he could not trace it in the living body; if this be true in health, what must it be in disease, where the parts are wedged and niched into every interstice around? Those who assert, that they have extirpated the parotid gland, have, I am fully convinced, mistaken that little conglobate gland, which lies imbedded in its substance, and which does sometimes enlarge, producing a tumour resembling a diseased parotid, for the parotid itself."

In order to obtain a satisfactory view of the course of the internal maxillary artery, and of its principal branches, the student may first make a vertical section of the head and face at one side of the septum narium, then dividing the zygomatic process near its root with the saw, also the malar bone at its junction with the frontal, and again, above its connexion to the superior maxillary, the zygomatic arch may be raised; the side of the lower jaw (which bone has been already divided at the symphisis) may be drawn outwards and back-

wards, so as to partially luxate the condyle, the coronoid process may be cut off near its root, and removed with part of the temporal muscle; a considerable quantity of loose adipose substance, which extends from between the pterygoid muscles to the buccinator should then be torn away, and the tortuous course of the internal maxillary artery will be partly exposed. This artery, at its origin, is imbedded in the parotid gland, and is nearly on a level with the lower extremity of the lobe of the ear; it first bends downwards and inwards, between the ramus of the jaw and its internal lateral ligament, which is inserted into the edge of the dental foramen; the artery then inclines inwards, between the dental and gustatory nerves, and enters a space which is bounded above by the external pterygoid muscle, below by the internal pterygoid, internally and anteriorly by the buccinator, and externally, or towards the surface, by the ramus of the jaw, and the insertion of the temporal muscle: through this space the artery runs in a very tortuous manner; it then winds over the external pterygoid, and passes between it and the temporal muscle; lastly, it turns downwards, forwards, and inwards, between the two origins of the external pterygoid, into the pterygo-maxillary fossa.

The internal maxillary artery is remarkable for the number of its branches; these may be arranged into three sets;—first, Those derived from the artery while it is between the neck of the lower jaw and the internal lateral ligament;—secondly, Those that are given off, while the artery is surrounded by muscles;—and

lastly, The terminating branches which arise in the pterygo-maxillary fossa.

1st Order.—1. ARTERIA MENINGEA MEDIA is one of the largest branches of the internal maxillary; it arises from the superior part of the artery on the inside of the neck of the lower jaw, ascends vertically to the base of the cranium, between the internal lateral ligament and the tensor palati muscle, gives off branches to the parts on either side, and near the base of the cranium, it sends small arteries to the Eustachian tube, some of which enter the tympanum, and supply the muscles in that cavity; the artery then enters the foramen in the spinous portion of the sphenoid bone. The course of the arteria media, within the cranium, may be seen without removing the dura mater; it passes outwards and upwards, ramifying on the internal surface of the temporal and parietal bones; in this course, passing off the spinous process of the sphenoid bone, it grooves the squamous part of the temporal along its anterior margin, sending several branches posteriorly, one of which passes through the hiatus Fallopii to the internal ear; it also sends smaller branches forwards towards the orbit, some of which enter that cavity through the foramen lacerum, and anastomose with branches of the ophthalmic artery. The middle meningeal artery then ascends to the anterior and inferior angle of the parietal bone, which it grooves very deeply; in some instances it is perfectly enclosed in bone, and separated from the dura mater; it then divides into a number of ramifications, one large branch ascends towards the vertex,

parallel and posterior to the coronal suture, and anastomoses with that of the opposite side; the other branches all extend upwards and backwards, and gradually end in minute twigs, some of which go to the dura mater, others to nourish the bones of the cranium: this artery has no accompanying vein.

Although this artery is commonly called the middle artery of the dura mater, (which name appears to imply, that it belongs exclusively to that membrane,) yet, it appears at least equally destined to be a nutritious vessel to the bones of the cranium, for it lies external to the dura mater, and not between its laminæ; and when minutely injected in the fœtus, (at which age it is proportionably larger than in the adult,) the injection does not colour the dura mater, but displays the vascularity of the bone; branches are certainly sent to the former, but not more than the periosteum receives from the nutritious vessels of any bone.

I have always considered the bones of the cranium to receive their principal supply of blood from their internal surface; to this the dura mater has a much more vascular connexion than the pericranium has to their external surface; this is equally obvious in the young and old subject, in both the dura mater adheres more intimately to the bones than the pericranium does; and even in the oldest skull, when its external table appears white and polished after the pericranium is detached, the internal surface will be found dotted with numerous red spots, which are the extremities of the ruptured vessels which served to connect the dura mater to the bone. The separation or de-

struction of a portion of the pericranium in the living subject, is not necessarily, nor even commonly, followed by the death of the exposed bone, whereas this is almost uniformly the consequence of a separation of the dura mater from any part of the cranium. Near the sutures the bones receive branches from without, which anastomose with the vessels of the diploe, and with those on their internal surface; processes or prominent parts also receive distinct arteries from those in the vicinity, as we observe in the superciliary arch, in the mastoid process, and in the irregular projections of the occipital bone; in the base of the cranium too, the bones are not only supplied from the arteries of the dura mater, but also receive innumerable branches from the pharyngeal and internal maxillary, and from every other artery in that situation.

Blows or falls on the side of the cranium sometimes rupture the trunk or branches of the meningeal artery, which cause so great an effusion of blood between the dura mater and bone, as to compress the former against the brain, and, consequently, disturb or suspend the functions of this nervous system; the effusion of blood may occur in some instances without the skull being fractured, in others, the wound of the artery may be caused by a spiculum of broken bone; in either case, when the bone has been removed, the hæmorrhage can be restrained by very slight compression—a small dossil of lint is sufficient; this fact has very properly removed all apprehension from the the minds of modern surgeons, of applying the trepan over the line of this artery. All the arteries within

the cranium are very delicate in their structure, they more resemble veins, and appear to be almost deprived of the middle or elastic coat, at least this is so weak as not to bear off any pressure that may be applied; whether this be the proper explanation for such slight means being sufficient to restrain hæmorrhage of an artery of this size, or whether it depend on the debility induced by the injury or by the operation, I cannot pretend to decide.

2. ARTERIA DENTALIS, VEL MAXILLARIS INFERIOR, arises opposite the last described artery; it descends with the dental nerve, between the internal lateral ligament and the neck of the lower jaw, gives a few small branches to the internal pterygoid muscle, to the superior constrictor of the pharynx, and to the mucous membrane of the mouth and fauces; it also gives a long branch to the mylo-hyoid muscle, it then enters the dental foramen, and takes the course of the canal, which traverses the sides and body of the lower jaw; beneath each of the alveoli branches ascend from it to supply the teeth; these enter the small pores in the extremity of each tooth, and supply their internal bony structure. The dental artery terminates anteriorly, by dividing into two branches; one continues in the canal beneath the incisores, the other escapes through the mental foramen, which is beneath the canine teeth, and divides into several small branches, which anastomose with the submental, inferior labial, and inferior coronary arteries; this branch is also accompanied by a branch of the dental nerve: if the dental artery be injected minutely, and the lower jaw

corroded in a weak acid, the alveolar branches may be beautifully displayed, particularly if the bone be from a subject about eight years of age. In the operation of extracting the last molar tooth, the trunk of the dental artery has been injured, and has bled profusely: the anterior edge of the dental foramen is about half an inch distant from the crown of this tooth, but the dental canal is immediately below its roots, and in the extraction of these the dental nerve and artery may be lacerated. In some persons, and perhaps from some constitutional cause, the extraction of any of the teeth is frequently followed by hæmorrhage, which becomes alarming from its long continuance; in such cases the coagulum of blood (through which the fresh bleeding appears to ooze) should be entirely removed, and a small piece of sponge of a conical form should be pressed down to the lowest point of the socket, and be retained there by graduated compresses for a considerable time; in some cases of this nature, it has been necessary to have recourse to the actual cautery after ordinary stiptics have failed.*

2d Order.—When the internal maxillary artery has entered the space bounded by the muscles before-mentioned, it gives off several branches, the principal of which are the following:—

* In the 8th vol. of the Medico-Chirurgical Transactions, a case of this kind is related, in which the carotid artery was tied, but the hæmorrhage proved fatal: replacing the tooth has proved successful, when other forms of pressure have failed.

3. ARTERIÆ PTERYGOIDEÆ are fasciculi of small arteries which supply the two pterygoid muscles.

4. ARTERIÆ TEMPORALES PROFUNDÆ are two in number; both lie close to the bones composing the temporal fossa, one near the root of the zygoma, the other near the malar bone, through which small branches pass into the orbit; they ascend on the side of the cranium, supply the temporal muscles, and anastomose with the middle and superficial temporal arteries. The anterior temporalis is the larger, it sends some branches into the orbit through the malar bone.

5. ARTERIÆ MASSETERICÆ are two or three branches which pass outwards in front of the neck of the lower jaw, through the sigmoid notch between the condyle and the coronoid process of this bone, and entering the substance of the masseter muscle, divide into several branches, which anastomose with the temporal and transversalis faciei arteries.

6. ARTERIÆ BUCCALES. Some of these are long and tortuous vessels; they descend obliquely forwards, between the internal pterygoid muscle, and the ramus of the jaw to the buccinator muscle, along which they run more transversely towards the integuments of the cheek and angle of the mouth, and anastomose with the labial and other arteries of the face.

7. ARTERIA DENTALIS VEL MAXILLARIS SUPERIOR, arises near the tuberosity of the superior maxillary bone; it runs in a very serpentine manner above the alveolar processes of this bone; some branches enter the antrum, and others perforate the small

openings in the alveoli, and supply the roots of the teeth: this artery anastomoses very freely with the infra orbital artery. Most of the foregoing branches are accompanied by large branches of the inferior maxillary nerve; those of the following order by branches of the superior maxillary.

3d Order.—The internal maxillary having turned downwards and forwards into the pterygo-maxillary fossa, divides into three branches, besides giving off some smaller twigs of little importance.

8. Arteria infra-orbitalis, in size appears the continued trunk of the artery; it runs forwards and upwards, enters the infra-orbital canal, through which small branches pass into the orbit to the fat and muscles there; others descend to the antrum, and alveoli, while the continued trunk accompanies the infra-orbital nerve, being placed beneath it, to the face, where it spreads out into a lash of branches, which anastomose freely with the labial and transversalis faciei arteries: as this artery escapes from the infra orbital foramen, it is covered by the orbicularis palpebrarum, and the outer portion of the levator labii superioris alæque nasi muscle, and it lies on the levator anguli oris, to all these muscles, as also to the ala nasi and to the upper lip it sends many branches.

9. Arteria palatina descendens descends in the posterior palatine canal, divides into two branches, the smaller one passes through the small hole in the pterygoid process of the palate bone, and is lost in the velum palati; the larger branch descends in the canal to the palate, then turns forward and runs

close to the palate-plate of the maxillary bone inside its alveolar arch; this artery supplies the mucous membrane and glands of the palate, and sends a small branch through the foramen incisivum to the nose, which anastomoses with the nasal arteries.

10. ARTERIA NASALIS passes through the spheno-palatine foramen into the superior meatus of the nose, above the posterior extremity of the middle spongy bone; it immediately divides into several branches, two or three pass backwards beneath the body of the sphenoid bone to the upper part of the pharynx, and ramify on its mucous surface, (these pharyngeal branches often arise distinctly from the internal maxillary,) the other branches of the nasal ramify on the mucous membrane of the nose; some run across to the septum nasi, one of which accompanies the nerve of Cotunnius to the foramen incisivum, and anastomoses with the palatine artery; the other nasal branches supply the mucous membrane; a small branch is usually sent backwards either from the nasal or palatine, to the vidian foramen of the sphenoid bone, and accompanies the vidian nerve. All the nasal and palatine arteries lie close to the bone, or periosteum, and their minute branches are innumerable; these are very fine and short, and are soon lost in the mucous tissue; they are best displayed by breaking and removing the thin laminæ of bone, and leaving the arteries adhering to the mucous membrane.

ARTERIA CAROTIS INTERNA, VEL PROFUNDA.

In the child this artery is larger than the external carotid, but in the adult they are nearly of equal size. The internal carotid artery ascends in front of the transverse processes of the three superior cervical vertebræ to the base of the cranium, enters the foramen caroticum in the petrous part of the temporal bone, winds through an oblique canal in that bone, and through the cavernous sinus, then rising by the side of the sella turcica, it becomes attached to the base of the brain, and divides into two large branches to supply the anterior and middle lobes of the cerebrum. In order to examine this artery more accurately, it may be divided into three portions: first, the cervical, which extends from its origin to the base of the cranium; secondly, its passage through the temporal bone and cavernous sinus;—and thirdly, the cerebral portion or termination within the cranium. The internal carotid artery, immediately after its origin, swells outwardly towards the side of the neck, then ascends, inclining inwards and a little forwards, and as it approaches the foramen in the temporal bone, it becomes very tortuous, and is often inflected to either side, so as to form different curves, the direction and extent of which are very irregular. The internal carotid artery, in this course, lies, at first, on the rectus capitis anticus major muscle, afterwards on the vagus nerve, and ganglion of the sympathetic; the internal jugular vein is external and poste-

rior to it, the lingual nerve is also external to it, but near the base of the skull this nerve is behind the artery, for in passing from the anterior condyloid foramen of the occipital bone, it runs outwards in front of the vein and behind the artery; the nerve then descends along the external side of these vessels, and opposite to the os hyoides it arches across the neck, superficial to both internal and external carotid arteries. The parts anterior to the internal carotid, are the external carotid artery and its branches, the styloid process and styloid muscles, also the digastric muscle, the lingual, glosso-pharyngeal and facial nerves, and the parotid gland. The internal carotid artery is separated from the external, by the styloid process, by two of the styloid muscles, by the glosso-pharyngeal nerve, and by part of the parotid gland. The pharynx is on the internal side of the carotid, loosely connected to it below, but more closely above; the tonsil also is internal, and a little anterior to this artery, united to it in health only by loose cellular membrane, but in cases of suppurative inflammation of this gland, it becomes so closely connected not only to this artery, but also to the external carotid and facial arteries, that in opening an abscess in this gland in an incautious manner, there is considerable danger of wounding some of the vessels; the student should, therefore, particularly examine the situation and connexions of the tonsil; if a vertical section of the head have been made, as was before directed, in order to expose the internal maxillary artery, he may obtain a good view of the relations of this oval body; he will

find that the tonsil is placed in a recess between the arches of the palate; that the palato-glossus muscle is anterior to it, and the palato-pharyngeus muscle is behind it; that it is covered externally by the superior constrictor, and stylo-glossus muscles, and by a quantity of cellular and adipose membrane, which leads towards the angle of the jaw, from which the lower extremity of this gland is somewhat less than an inch distant. The tonsil is supplied with blood by several small arteries, it is also nearly surrounded by a plexus of veins. In cynanche tonsillaris there is, in general, considerable swelling of the tonsil and surrounding cellular membrane; the gland enlarges, first in a direction inwards, so as to meet the opposite tonsil, it then extends itself backwards towards the vertebræ, and downwards and outwards towards the angle of the jaw, beneath which a fulness is perceptible, and acute pain is felt on pressure, or on any attempt to swallow; when the tonsil is thus enlarged, it will be found in close apposition to some of the principal vessels of the neck; namely, to the internal carotid artery and jugular vein posteriorly, to the superficial carotid externally, and to the facial artery anteriorly and inferiorly; the small vessels which supply the gland itself will be found increased in number and size. In opening an abscess in the tonsil, the surgeon should particularly recollect the proximity of the carotid arteries, and avoid directing the lancet or trochar either outwards or backwards, but rather inwards, towards the pharynx; a small opening will, in general, be sufficient, and will be found preferable to a large one,

for through the former the matter will escape gradually, and by the efforts of the patient; whereas, if a free incision be made, he may be suffocated by the sudden discharge of pus and blood descending into the throat.

The cervical portion of the internal carotid gives off no regular branch; sometimes the pharyngea ascendens arises from it; of this, however, I have seen but one instance.

Posterior to the Eustachian tube and levator palati muscle, the internal carotid artery enters the foramen caroticum, and pursues its serpentine course through the canal in the petrous bone, and through the cavernous sinus; to expose this middle division of the artery, the student should remove the lower jaw, the styloid process and styloid muscles, also the parotid gland, then cut out a triangular piece of the temporal and sphenoid bones with the saw, by directing the edge of this instrument inwards and forwards through the side of the cranium, and through the anterior part of the meatus auditorius externus, towards the foramen lacerum anterius, and then meet the internal extremity of this incision by another, which should be directed inwards and backwards through the great wing of the sphenoid bone towards its spinous process; a slight blow will detach this triangular piece of bone, and lay open the carotid canal, in which the artery is observed to run in a very serpentine manner, first obliquely upwards, then forwards and inwards; emerging from this canal it next enters the cavernous sinus, along the lower part of which it runs, first upwards and forwards, then it

bends a little downwards, and proceeds nearly horizontally by the side of the sella turcica, and, lastly, arriving at the anterior clinoid process, it ascends inclining a little backwards: its course through this sinus resembles the letter *s* placed horizontally, but is much more tortuous. In its course through the bony canal, which it nearly fills, the artery lies at first anterior to the tympanum, from the cavity of which it is only separated by a thin transparent plate of bone, which in the very young subject is cribriform, and in the very old is sometimes absorbed: as the artery runs forwards, it lies inferior and external to the bony case of the cochlea, and inferior to the Eustachian canal, above which, however, it gradually rises, and at the foramen lacerum anterius, a firm gristly substance separates these two: the proximity of this large artery to the parts concerned in the function of hearing, may account for the great and sensible effects which are produced upon this delicate organ, by the preternatural or morbid action of the arterial system.

From the time the internal carotid artery first enters the bony canal in the temporal bone, until it emerges from the cavernous sinus, it makes at least five or six acute turns, some of which are almost at right angles, these probably tend to diminish the effect of the heart's action on the cerebral circulation, in a manner analogous to but less perfectly than is effected in most of the mammalia, by that very peculiar arrangement called the rete mirabile.*

* Anat. Comp. by Cuvier, vol. ii. p. 192.

In cases of fractures of the cranium, which traverse its base, the petrous portion of the temporal bone is generally cracked, and there is bleeding from the external ear: does this proceed from a rupture of small vessels only, or is the trunk of this artery ever injured? My own experience does not enable me to decide: in some cases, the blood flows very freely, and for a considerable time; whereas, in others, the hæmorrhage is very slight, and the discharge is principally serum. In one case of extensive fracture of the base of the cranium, in which there was bleeding from the ear, and which I had an opportunity of examining after death, I found that the blood proceeded from the lateral sinus; the fracture had extended through the petrous and mastoid portions of the temporal bone, and a small probe could be passed from the tympanum into the lateral sinus; the internal layer, however, of the dura mater was not injured, and consequently there was no extravasation of blood between this membrane and the brain.

As the carotid artery passes through this canal, it is accompanied by one or two small veins which communicate with deep seated veins in the neck, and with the cavernous sinus above, also by two or more branches from the superior cervical ganglion of the sympathetic nerve; these lie on the posterior and external side of the artery; they have a reddish appearance; at first view, they are rather indistinct, but when carefully examined, particularly if first immersed for a short time in alcohol, they become very evident; they form a plexus round the artery; the branches of

this plexus are soft and broad, and may be traced for some distance on the divisions of the carotid, and on the ophthalmic artery. This portion of the internal carotid artery appears to have a greater number of nerves, and these of a larger size, than any other part of the arterial system: in several situations, however, we find that the external coat of arteries is freely supplied with nerves which are principally derived from the sympathetic or ganglionic system; thus the aorta and pulmonary artery, at their origin, are surrounded by branches from the cardiac plexus; these are very pale and soft; the branches of the external carotid also are each enveloped by a plexus of nerves from the sympathetic, branches of which may be traced on the coats of these vessels to a considerable distance; in like manner, the coronary arteries of the heart, the spermatic arteries, and those of the abdominal viscera, are each surrounded by a plexus of nerves, branches from which twine around these vessels and their ramifications. The arteries of the extremities have not so many or such large nerves for their supply, as those blood-vessels that are destined to nourish organs which have particular functions to perform, or parts which possess a peculiar or a high degree of sensibility. When the nerves that form this plexus around the internal carotid artery, are traced as far as the cavernous sinus, they present the appearance of a plexus, and sometimes of a ganglion, from which branches may be observed to pass off in different directions, and to unite with several of the cerebral nerves; two branches ascend to join the sixth pair of nerves in the

cavernous sinus; a slight expansion, like a ganglion, marks the situation of their union on the external side of the carotid artery; the abducens nerve is larger from this point to the orbit, than it was previous to this connexion with the sympathetic; other branches of this plexus pass outwardly, and join the ganglion or plexus of the fifth pair, particularly the ophthalmic division of it; one branch of it may be observed to join the nasal twig of the ophthalmic, and may be traced to the lenticular or ophthalmic ganglion, in which it joins a branch from the third pair of nerves; a small branch from the carotid plexus may be traced forwards through the vidian foramen of the sphenoid bone, in connexion with the vidian nerve through the vidian foramen of the sphenoid bone to the pterygo-maxillary fossa, where it joins the ganglion of Meckel, branches from which twine round the internal maxillary artery; another branch of the carotid plexus passes backwards, and enters the vidian foramen of the temporal bone, along with the superior branch of the vidian nerve, which nerve attaches itself to the side of the portia dura, crosses the cavity of the tympanum, under the name of chorda tympani, and escaping through the fissure in the glenoid cavity of the temporal bone, joins the lingual branch of the inferior maxillary nerve; other branches of the carotid or cavernous plexus may be traced along the ophthalmic artery, a minute twig also may be seen uniting with the trochleator nerve, and the remaining filaments ascend on the carotid artery and its ultimate branches. Thus may a communication be shown to exist between the sympathetic nerve and most of the cerebral

nerves; in the neck, branches from the superior cervical ganglion are interwoven with branches from the seventh, eighth, and ninth pair, and in the carotid canal the branches of the carotid plexus serve to connect the sympathetic with the third, fourth, fifth, and sixth pair of nerves; the branches of this plexus also serve to connect the several ganglions of the head to the sympathetic nerve or ganglionic system: I am also disposed to think, that a somewhat similar connexion exists between this system and the several ganglions of the spinal nerves.*

The carotid artery, in its passage through the cavernous sinus, is commonly described as "being bathed in the blood of that sinus;" it is, however, separated from the fluid in this cavity by a fine membrane. The cavernous sinus extends from the side of the body of the sphenoid bone, to the anterior extremity of the petrous bone; its parietes, like those of other sinuses, are formed by the dura mater, dividing into two laminæ, of which the superior layer is the stronger, and forms the roof of this sinus; the inferior layer is thin, and adheres, like periosteum to the surface of the bones; similar to other sinuses, this is also lined by a fine membrane continued from the ophthalmic vein

* I have given a more full description of these nerves than may appear necessary in a work of this kind; but as I presume the student has made the dissection, as directed, to expose the carotid artery, I think he may take this opportunity of examining these branches of the sympathetic, most of which can be seen in this dissection with very little additional trouble.

anteriorly, and the petrous sinuses posteriorly; the interior of this sinus has a cellular appearance, not unlike the corpus cavernosum penis, hence it has received the name of cavernous sinus; this cellular appearance is principally caused by small branches of the carotid artery, and of the carotid plexus of nerves, crossing the cavity in different directions. As the carotid artery, sixth pair of nerves, and branches of the sympathetic, perforate the fibrous wall of this sinus, its lining membrane is reflected from the edges of these different openings, on this vessel, and on these nerves, and covering them, completely separates them from the blood contained in the sinus: in a recent subject this membrane can be seen distinctly, for as the artery is much curved, this fine transparent membrane is very obvious, as it is extended from one convolution of the vessel to another.

As the carotid artery winds through the temporal bone, it gives off one or two small branches to the tympanum: in the cavernous sinus also, it gives off two or more branches, called,

1, 2. ARTERIÆ RECEPTACULI. These interlace with branches of the sympathetic nerve, supply the dura mater in this region, and some pass outwardly to the ganglion of the fifth pair of nerves, and anastomose with the middle artery of the dura mater.

At the side of the sella turcica, the carotid artery perforates the dura mater, and now commences its cerebral division. As this part of the carotid ascends, it inclines backwards, presenting a convexity towards

the orbit; the arachnoid, or serous membrane, is reflected round it to the inferior surface of the brain, and at the internal extremity of the fissure of Sylvius, the artery divides into its terminating branches. In this situation, the carotid artery has the optic nerve on its internal, and the motor oculi nerve on its external side; the fourth, fifth, and sixth pair of nerves are also external to it, but they are at a greater distance from the vessel. The proximity of this large artery to these two principal nerves of the organ of vision, (one of which is to become the very seat of that sense, and the other to supply so many of its appendages,) may explain how some derangements of this organ may depend on an altered condition of this vessel, either from temporary excitement, or permanent disease. As the carotid artery is emerging from the cavernous sinus, it sends off, close to the anterior clinoid process,

3. Arteria ophthalmica. This artery enters the orbit by the foramen opticum, and is destined to supply the eye and its appendages, as well as a part of the integuments and muscles of the forehead. To trace the ramifications of this artery, the roof of the orbit must be raised; when the calvarium has been removed, this may be done by two cuts with a saw, which should unite in the foramen lacerum a little to the outside of the foramen opticum; the external incision should divide the os frontis through its external angular process, and the internal incision should divide this bone on the outside of its internal angular process; the roof of the orbit may then be everted,

and thrown forward, the dura mater adheres so closely to the periosteum, that this membrane is always detached from the bone in opening the orbit in this manner. The small branches of the ophthalmic artery are seldom filled when the arterial system has been injected from the heart with the coarse red injection. If the student, however, wishes to trace its minute branches, let him insert a small pipe into the artery itself at its origin, and immersing the orbit and surrounding parts in warm water, inject some fine size injection; in this way, all its branches, even those of the iris and choroid coat, may be filled.

The ophthalmic artery runs forwards through the optic foramen, enclosed in a small canal or sheath derived from the dura mater; it is a very tortuous artery, and completely twines round the optic nerve; being at first inferior to this nerve; then running along its outer side, and soon rising over it, crosses to its internal side, and then passes horizontally forwards along the inner wall of the orbit, to the side of the nose, where it divides into ascending and descending branches. The ophthalmic artery is less remarkable for its size than for the number of its branches; these may be arranged into three orders, according to the situation of the trunk of the artery; the first arises from the ophthalmic artery external to the optic nerve; this consists of the lachrymal and centralis retinæ; the second arises from the ophthalmic, above the optic nerve; this consists of the supra orbital, ciliary, and muscular; and the third set arises from the ophthalmic at the nasal

side of the orbit, and consists of the ethmoidal, palpebral, nasal, and frontal arteries.

1. Arteria lachrymalis is one of the largest branches of the ophthalmic artery; it arises close to the foramen opticum, and sometimes before the ophthalmic artery has entered the orbit; the lachrymal artery runs along the upper edge of the abductor oculi muscle, gives small branches to it, sends one or two through the malar bone to anastomose with the deep temporal arteries; it then runs to the upper surface of the lachrymal gland, and divides into several small branches, which form a network around it, and there enter its substance; one or two are also sent to the superior and inferior palpebræ, and anastomose with the proper palpebral arteries. There are frequently two lachrymal arteries, and sometimes the middle artery of the dura mater sends a branch through the lacerated opening in the orbit to the lachrymal gland. The lachrymal sometimes arises from the middle artery of the dura mater, in which case it will enter the orbit by the foramen lacerum.

2. Arteria centralis retinæ is one of the smallest branches of the ophthalmic artery; it arises near ths foramen opticum, penetrates the optic nerve, runs in its centre, and having arrived at the posterior part of the vitreous humour, it divides into a number of small branches, which are connected together by a fine cellular tissue, and assist in forming the internal layer of the retina, external to which is its peculiar medullary matter; a branch of this artery also pene-

trates the vitreous humour, supplies the hyaloid membrane, and in a successful injection may be traced to the capsule of the crystalline lens. When the optic nerve is divided, a small dark speck is observed on each cut surface; this is the divided artery, and has been named the porus opticus. The hyaloid branch, which penetrates the vitreous humour, is very distinct in the eye of the sheep or ox, or in a very fresh human eye. The arteria centralis retinæ sometimes arises from some of the branches of the ophthalmic, and not from its trunk.

3. ARTERIA SUPRA ORBITALIS arises from the ophthalmic artery above the optic nerve, and is usually its largest branch; it first ascends, so as to rise above all the muscles in the orbit, and to lie close to the periosteum; it accompanies the frontal nerve, and runs forwards to the superciliary notch or foramen, where it often appears larger than at its origin; it then turns round the superciliary arch, and spreads its branches on the forehead; this artery, in the orbit, supplies the levator oculi, and levator palpebræ muscles; near the base of the orbit, it sends a branch towards the trochlea of the oblique muscle; this gives small branches to the parts at the inner canthus of the eye, and to the superior palpebra; as the supra orbital artery passes through the superciliary notch, it sends a branch into the diploe of the os frontis, and then ascending on the forehead, it divides into several branches, some of which run inwards towards the nose, and anastomose with the angular branch of the facial artery, and with arteries from the opposite side; others ascend on the

forehead to supply the integuments, and occipito-frontalis muscle, and anastomose with the temporal artery; some of these branches are very large, and will occasionally afford blood when opened for inflammatory affections of the eye. The trunk of the supra orbital artery, although near the surface, ought never be selected for arteriotomy, as not only must the orbicularis palpebrarum and occipito-frontalis muscles be wounded, but also the frontal nerve, and repeated instances have occurred of wounds of this nerve producing unpleasant consequences either to some of the muscles of the eye, or to vision itself. If a line be dropped perpendicularly from the superciliary notch to the side of the lower jaw, it will correspond to three foramina, viz., the supra orbital, infra orbital, and mental, through each of which pass an artery and a branch of the fifth pair of nerves.

4. ARTERIÆ CILIARES. These are fasciculi of small arteries which are remarkably tortuous, and are accompanied by delicate nerves of the same name; they have no regular or exact origin, most of them arise from the trunk of the ophthalmic, but frequently some arise from the ethmoidal, supra orbital, or from some muscular branches; they are at first about eight or ten in number, some twine round the optic nerve in a spiral manner, they soon subdivide and inosculate with each other, and having arrived at the sclerotic coat, they appear much more numerous, even fifteen or twenty may be easily perceived; at about two lines, or rather less, anterior to the entrance of the optic nerve, these arteries penetrate the sclerotic, most of

them terminate in the choroid coat, and are named the short ciliary arteries, while on either side one branch is observed to continue its course onwards, passing horizontally between the sclerotic and choroid membranes as far as the ciliary body; these are named the long ciliary arteries; they are parallel to the long axis of the eye, and are accompanied by nerves of the same name. At the ciliary body each of these arteries divides into two branches, which, passing through the ciliary ligament, subdivide, and by numerous inosculations with each other, and with small arteries which perforate the sclerotic near the cornea, form a perfect circle of blood-vessels at the circumference of the iris; from this circle proceed branches like rays towards a centre, which, subdividing and anastomosing, form a complicated kind of net-work, or a second circle within the former; and from the concavity of this proceed small branches, which run and subdivide in the same manner, and uniting again, form another circle smaller than either of the former, and very near to the opening of the pupil. The long ciliary arteries generally arise more regularly from the trunk of the ophthalmic than the short ones, and the latter perforate the sclerotic, nearer the optic nerve than the former. In a successful injection, the choroid coat appears entirely composed of vessels like the villous surface of the stomach or intestines; in a state of health, however, these numerous vessels do not transmit red blood. The situation of the long ciliary arteries and nerves should be remembered in the operation of couching or depression of the cataract; to

avoid injuring these, the needle must be introduced about two lines below the horizontal diameter of the eye.

In addition to the long and short ciliary arteries, the choroid coat and iris receive small vessels from the muscular branches of the ophthalmic; these are named by some authors the anterior ciliary arteries, they perforate the sclerotic about one or two lines behind the cornea; some branches go to the iris, and anastomose with the long ciliary arteries, others go to the choroid coat, and communicate with the short ciliary; numerous arteries from all these enter the ciliary processes and iris. The particular arrangement of these arteries has been matter of dispute among anatomists, and deserves to be more particularly considered in the minute examination of the organ of vision, than in a description of the general arterial system; I may, however, here observe, that I have remarked the posterior surface of the iris to be much more vascular than the anterior, the fibrous and fasciculated appearance of which appears to me to be independent of vascular arrangement.

5. Rami musculares. These are uncertain in number and origin; the superior branches often arise from the supra-orbital artery, supply the levator palpebræ, and levator oculi muscles; the inferior muscular artery descends on the inner side of the optic nerve, first sends a considerable branch to the external rectus, and then supplies the inferior rectus and inferior oblique muscles; it also sends small branches to the fat in the orbit; these anastomose with the infra-

orbital from the internal maxillary, some branches also pass to the inferior eyelid and lachrymal sac; these muscular branches, in general, accompany the branches of the third pair of nerves, and are distributed to the optic surface of each muscle as the nerves are; this rule, however, is not so regular with regard to the arteries as it is with respect to the nerves, all of which, except the fourth pair, enter the optic surfaces of the muscles.

6. ARTERIA ETHMOIDALIS, arises from the ophthalmic artery on the inner side of the optic nerve, passes through the foramen orbitale internum posterius, crosses the cribriform lamella of the ethmoid bone, and supplies the ethmoid cells and the mucous membrane of the nose, on which its branches anastomose very freely with the proper nasal arteries from the internal maxillary; a small branch from the ophthalmic also passes through the foramen orbitale internum anterius, and is distributed to the nose in the same manner as the last described branch.

7, 8. ARTERIA PALPEBRALIS, SUPERIOR ET INFERIOR. These arteries arise near the inner angle of the orbit; the superior arises immediately above the tendon of the orbicularis palpebrarum, runs outwards, and divides into branches to supply the superior palpebra, the principal branch, or the internal palpebral artery, runs near the orbital edge of the tarsal cartilage, and supplies the meibomian glands, and the conjunctiva lining the eyelid, and that covering the eye; the other branches are distributed to the muscles and integuments of the eyelid, and anastomose

with the supra-orbital artery, and with the external palpebral branches from the lachrymal. The inferior palpebral artery descends behind the tendon of the orbicularis muscle on the outer side of the lachrymal sac, gives branches to it and to the fibres of the orbicular muscle, then passes outwards, and divides into branches for the lower palpebra, which run in the same manner as those of the superior; these anastomose with the angular, infra orbital, transverse facial, and temporal arteries. From branches of the palpebral arteries blood sometimes flows very freely from scarifications made on the internal surface of the eyelids.

9. Arteria nasalis is one of the terminating branches of the ophthalmic artery; it passes out of the orbit between the trochlea of the oblique muscle and the tendon of the orbicularis, and descends along the side of the nose; this artery sends branches to the lachrymal sac and inferior palpebra, and anastomoses with the angular branch of the facial artery.

10. Arteria frontalis is the last branch of the ophthalmic artery; it passes out of the orbit along with the nasal branch, but takes a different direction; the frontal artery turns upwards on the forehead, divides into several branches, which supply the occipito-frontalis and corrugator-supercilii muscles, and anastomose with the supra-orbital artery and with arteries from the opposite side.

The student should next proceed to trace the branches which the internal carotid artery gives to the brain. The most satisfactory view of these arteries,

and of their natural relations to the different parts at the base of this organ, may be obtained by examining them when the whole brain is removed from the cranium, together with the different arteries that supply it; first cutting across each internal carotid after it has given off the ophthalmic artery, and then dividing the vertebral arteries in the foramen magnum, and each of the nerves at their exit from the cranium, in the ordinary way of removing the brain for the purpose of dissection.

Each internal carotid artery divides at the base of the brain into three branches, named arteria communicans posterior, arteria cerebri anterior, and arteria cerebri media; the first-mentioned branch is the smallest, the last is the largest of the three. When the student has exposed these branches of the carotid artery, he had better refer to the description of the basilar artery, which is formed by the union of the vertebral arteries, and thus take a connected view of the cerebral vessels. The internal carotid, after giving off the ophthalmic artery, sends backwards the following branches:—

4. ARTERIA POSTERIOR COMMUNICANS: this is a small but a remarkable artery; it is about an inch in length; it runs backwards and inwards between the arachnoid membrane and the pia mater on the external side of the infundibulum and corpora mammillaria, and joins the posterior cerebral artery, a branch of the basilar, at the anterior edge of the pons varolii; thus this artery serves as a means of communication be-

tween the carotid and basilar arteries, and so assists in forming the circle of Willis: in this short course, this artery gives off several small branches to the pia mater; there is a plexus of minute arteries between the optic nerve and pons varolii beneath the third ventricle; this plexus is formed by branches from the posterior communicating arteries, and from the carotid and basilar arteries. The communicating arteries of opposite sides are nearly parallel to the third pair of nerves.

The internal carotid immediately after giving off the last described artery, divides into its two terminating branches.

5. Arteria cerebri anterior passes upwards, forwards, and inwards, towards the fissure between the anterior lobes of the cerebrum; this artery separates the optic from the olfactory nerves, lying above the former, and below the latter; when it enters the fissure between the anterior lobes, it approaches the artery of the opposite side, to which it is united by a short transverse branch, called "arteria communicans anterior;" sometimes the arteries of opposite sides unite, and form a single trunk, which, after a very short distance, divides into two branches, which pursue the proper course of the original arteries; this junction is analogous to that of the two vertebral arteries in the basilar. The anterior cerebral artery then runs horizontally forwards beneath the corpus callosum, or the commissura magna cerebri, round the anterior extremity of which it turns upwards and backwards, and then runs along its upper surface,

and soon divides into two branches, the inferior of which continues to run on the corpus callosum as far as its posterior extremity, where it terminates in branches which go to the internal side of each hemisphere of the cerebrum. The superior branch ascends from the corpus callosum, and is distributed to the internal surface of each hemisphere; this artery makes a remarkable curvature round the corpus callosum, first from behind forwards, then from below upwards, and, lastly, from before backwards; at first it only gives a few small branches to the base of the brain, but to the hemispheres it sends very long and tortuous arteries, which ramify on the pia mater very minutely before they enter the substance of the brain: these arteries supply principally the internal surface of the anterior and middle lobes of the cerebrum, a few branches only go to the posterior lobes.

6. ARTERIA CEREBRI MEDIA is much larger than the artery last described, and is remarkably tortuous; it bends outwards and backwards, sinks into the fissure of sylvius, runs upwards and outwards, and divides into a superficial and a deep branch, both of which give numerous branches to the pia mater on the anterior and middle lobes of the cerebrum, but chiefly to the latter. Before this artery enters the fissure, it sends a few branches to the pia mater at the base of the brain, and almost always sends a branch, called "choroid artery," which enters the inferior cornu of the lateral ventricle by a fissure between the optic thalamus and hippocampus major: this artery then runs into the choroid plexus, and ramifies through its

delicate tissue; the choroid artery sometim
from the posterior communicating artery, or f
carotid itself; sometimes a fasciculus of small l
enters each lateral ventricle by this fissure in
rior cornu.

clavicle. The external jugular vein and some branches from the shoulder and side of the neck join the subclavian vein in this situation, and in some subjects obscure the view of the artery very much. The position of the clavicle has great influence on the relative distance of the subclavian artery from the surface of the neck; if the shoulder be elevated and drawn forwards, a small portion only of the artery can be seen, and that at a great depth from the integuments; whereas, if the shoulder be depressed and directed backwards, the artery will appear much more superficial, and will be exposed through the whole of its third stage. When the shoulder is in this depressed position, a triangular space may be observed above the clavicle, between the sterno-mastoid and trapezius muscles; within this is a smaller space, which is bounded externally by the omo-hyoid muscle, anteriorly by the sterno-mastoid and scalenus muscles, and inferiorly by the clavicle and subclavian muscle; through this small space pass the brachial plexus of nerves, and the subclavian artery and vein; the nerves lie superior and external, the vein inferior and anterior to the artery, and one branch of the plexus of nerves inclines to the front of the artery near the lower part of this region. Besides the several veins which are to be seen here, two arteries of very considerable size may be generally observed passing across this space, namely, the supra-scapular and transversalis colli; the former is very near, and parallel to the subclavian muscle, the latter crosses this space higher up. From an attentive observation of

it arrives at the bend of the elbow, it receives the name of brachial or humeral artery. The right and left subclavian arteries differ from each other only as to their origin, and in the first part of their course; to this difference between these two arteries I shall particularly allude in the following description. In the number of branches, however, and in their termination, they agree so accurately that one description may apply to both. I should recommend the student first to trace the right subclavian artery.

ARTERIA SUBCLAVIA DEXTRA.

To expose this vessel, the sterno mastoid, hyoid, and thyroid muscles, should be divided about the centre of the neck, and thrown downwards over the clavicle and sternum: I prefer dividing the muscles in this situation, to detaching them from the sternum, as by the former method the student can replace them at pleasure, and so review the relations of the artery with more advantage: when the muscles are thus displaced, the deep cervical fascia divided, and a quantity of cellular and adipose membrane removed, the origin and course of the right subclavian artery is brought into view.

This artery arises from the arteria innominata, opposite the sterno clavicular articulation, passes upwards and outwards to the anterior scalenus muscle, behind which it runs; it then inclines downwards and outwards to the clavicle and subclavian muscle, under which it descends to the axilla; in this short course

it forms an arch, the convexity of which is upwards, and from which several large branches arise; the concavity of this arch looks downwards to the right lung. For the purpose of more accurately examining the relation of this vessel to the surrounding parts, the student may divide its course into three stages; the first extends from the origin of the artery, to the tracheal edge of the scalenus muscle; the second, or middle stage, is the transit of the artery between the scaleni muscles; and the third stage extends from these muscles, beneath the clavicle, to the lower border of the first rib; in these two latter stages, the right and left subclavian arteries are similar, but they differ essentially in the first. The right subclavian artery, in the first stage of its course, runs outwards, inclining a little upwards, and is covered by the integuments and cervical fascia, by the clavicular portion of the sterno-mastoid muscle, beneath which is a considerable quantity of loose cellular membrane and several small arteries and veins; it is also covered by the sterno-hyoid, and sterno-thyroid muscles, and by a dense fascia, which is continued from the arteria innominata to the anterior scalenus muscle. When these parts are removed, a small triangular space between the carotid artery and jugular vein is brought into view, the base of which space is formed by the subclavian artery, and here the nervus vagus may be seen crossing that artery at right angles; behind the jugular vein the anterior branches of the inferior cervical ganglion of the sympathetic nerve descend in front of the subclavian artery, and external to these is the phrenic

nerve running in the same direction. Thus, in the first part of its course, the right subclavian artery is covered by three layers of muscles, by the vagus nerve, by the internal jugular and vertebral veins, and by branches of the sympathetic nerve. The right subclavian artery in this stage has the recurrent laryngeal nerve posterior to it, also some cellular membrane and lymphatic glands, which separate it from the vertebræ, and from the triangular depression between the longus colli and the scaleni muscles; it then passes in front of the sympathetic nerve, and lies upon the pleura.

The right subclavian artery, in the middle division of its course lies on the pleura and middle scalenus muscle, is accompanied by the brachial plexus of nerves, and is covered by the sterno-mastoid and anterior scalenus muscles; the phrenic nerve and subclavian vein are also anterior to it, but are separated from the artery by the anterior scalenus muscle.

The subclavian artery, in the third part of its course, inclines downwards and outwards, and is covered only by the integuments, platisma, cervical fascia, and cellular membrane, the quantity and consistence of which vary much in different subjects. In this stage the artery lies on the middle scalenus muscle, and on the superior surface of the first rib; this bone is in general found grooved in the part corresponding to the artery; the brachial plexus of nerves and the omo-hyoid muscle are to its superior and acromial side; the subclavian vein is anterior and inferior to the artery, and is partly concealed by the

clavicle. The external jugular vein and some branches from the shoulder and side of the neck join the subclavian vein in this situation, and in some subjects obscure the view of the artery very much. The position of the clavicle has great influence on the relative distance of the subclavian artery from the surface of the neck; if the shoulder be elevated and drawn forwards, a small portion only of the artery can be seen, and that at a great depth from the integuments; whereas, if the shoulder be depressed and directed backwards, the artery will appear much more superficial, and will be exposed through the whole of its third stage. When the shoulder is in this depressed position, a triangular space may be observed above the clavicle, between the sterno-mastoid and trapezius muscles; within this is a smaller space, which is bounded externally by the omo-hyoid muscle, anteriorly by the sterno-mastoid and scalenus muscles, and inferiorly by the clavicle and subclavian muscle; through this small space pass the brachial plexus of nerves, and the subclavian artery and vein; the nerves lie superior and external, the vein inferior and anterior to the artery, and one branch of the plexus of nerves inclines to the front of the artery near the lower part of this region. Besides the several veins which are to be seen here, two arteries of very considerable size may be generally observed passing across this space, namely, the supra-scapular and transversalis colli; the former is very near, and parallel to the subclavian muscle, the latter crosses this space higher up. From an attentive observation of

the alteration that may be effected in this space by the change of position of the clavicle, the student may deduce some practical inferences, to which I shall allude when speaking of the operations that may be performed on the subclavian artery; but first let the student examine this artery on the left side.

ARTERIA SUBCLAVIA SINISTRA.

To expose this vessel, the superficial muscles of the neck should be divided, as before directed, the sternal end of the left clavicle dislocated, and the cartilages of the first and second ribs removed, together with the sternum; the left pleura also must be detached from the aorta, and pressed towards the left lung. The left subclavian artery arises from the posterior or descending part of the arch of the aorta, opposite the second dorsal vertebra, and ascends perpendicularly out of the thorax, as high as the inner edge of the first rib; it then, like the artery on the right side, passes outwards between the scaleni muscles, and pursues its course beneath the clavicle towards the axilla. The left subclavian artery, from its origin to the scalenus muscle, has posterior to it, and in contact with it, the vertebræ, the longus colli muscle, and the inferior cervical ganglion of the sympathetic nerve, and ascends along the left side of the œsophagus. Anterior to this artery, are the left lung and pleura, the nervus vagus and left carotid artery, the thoracic duct, left jugular vein and vena innominata, the sterno-mastoid,

hyoid, and thyroid muscles, also the sternum, first rib, and clavicle.

If the student now contrast the right and left subclavian arteries, he will observe the differences which exist between them in the first stages of their course; the left subclavian is longer, though in general smaller than the right, it arises from the aorta near the vertebræ, lies deep in the thorax, and ascends from this cavity in an almost perpendicular direction; while the right subclavian arises in the neck from the arteria innominata, is much more superficial than the left, and runs almost transversely to the scaleni muscles: the left subclavian is connected to the pleura through the entire of its first division; the vagus nerve and left carotid artery are parallel and anterior to it, whereas, on the right side, the artery has very little connexion to the pleura until it approaches the scaleni muscles, and the vagus crosses it at right angles. The relation of the venæ innominatæ to these arteries, differs on the right and left sides, the vein covering the artery more on the latter than on the former; the left subclavian artery also is exclusively connected to the œsophagus and thoracic duct. The left subclavian artery, in its middle and last stages, is in every respect similar to the right. I have already noticed the varieties that have been observed in the subclavian arteries, both as to their origin and in the early part of their course, see page 107.

Before the student proceeds to dissect the branches of the subclavian arteries he should consider what practical inferences may be deduced from the view he

has now obtained of these vessels. From this view he may learn in what situation compression can be made on the subclavian artery, so as to command the circulation in the superior extremity, in cases of operations about the shoulder, in the axilla, or on the upper part of the arm; from the dissection which he has made, he may perceive, that in one situation only can compression be effectually applied, and that is while the artery is descending from the scaleni muscles to the inferior margin of the first rib; if in a living person the shoulder be depressed, and the surgeon grasp the side of the neck, he may press his thumb into the hollow behind the clavicle, between the trapezius and mastoid muscles, so firmly as to obliterate the canal of the artery against the first rib: if the shoulder be not sufficiently depressed, it will be difficult to compress the vessel against that bone, but by making pressure in the same situation, and directing it a little backwards, the artery may be compressed against the middle and posterior scaleni muscles, and the transverse processes of the last cervical vertebræ.

Mr. John Bell, in the second volume of his Anatomy, states, that it is impossible to compress this artery above the clavicle, but that there is no difficulty in effecting it below that bone: at page 269, he says, "the old story of compressing the subclavian artery above the clavicle, is now of no credit with any surgeon of knowledge or good sense; the arch is so deep, and the muscles so strong, it is absolutely impossible. It passes out from under the arch of the clavicle, where it was protected, inclines outwards towards the

axilla, lies flat on the convexity of the chest, is covered by the pectoral muscles, but can here be felt beating, and at this point only can be rightly compressed."

Should any disease exist in the axilla which may cause the elevation of the clavicle, and prevent its being depressed, I believe it may be then impracticable to compress the artery above this bone; but, under any circumstances, I consider it almost impossible to make effectual compression upon this artery below the clavicle; to effect it the pectoral muscles must be put in a relaxed position, which will be found very unfavourable to any operation on the upper or inner part of the arm, or in the axilla. I should feel great diffidence in expressing my dissent from any opinion urged by a writer of such celebrity as Mr. Bell, were I not perfectly satisfied that every operating surgeon of the present day is impressed with the truth of the contrary fact, and has learned, from observation and experience, not only the possibility, but even, in many cases, the facility with which the subclavian arteries may be compressed above the clavicles, provided the shoulders can be depressed. Indeed, some individuals, by forcibly carrying the shoulder downwards and backwards, can for a time so completely suspend the circulation in the arm, as to stop the pulse at the wrist; the artery in this case is compressed by the clavicle and subclavian muscle against the first rib and the middle scalenus.

The student should next consider the operation of tying the subclavian artery, and by reviewing the parts exposed in the dissection which he has made, he

may learn in what situation a ligature may be most easily passed around that vessel in the living subject, and what parts are in danger of being injured in the operation. The surgeon may be required to tie the subclavian in cases of wounds of the axillary artery, or in cases of aneurism, immediately below or behind the clavicle; in such cases the surgeon has no alternative between attempting this operation and abandoning his patient.

As yet the records of surgery do not furnish many cases of success attending this operation; they are, however, sufficiently numerous and satisfactory to prove, not only the practicability of the operation, but also its expediency in many cases of aneurism, in which an operation is not contra-indicated by constitutional complaints, or rendered impracticable by those local obstacles, which in some cases have proved insurmountable, and which have been caused by the displacement or altered relation of different parts, in consequence of the long continuance or rapid extension of disease.

From such accounts, however, one conclusion is obvious, and must occur to the mind of every surgeon, namely, that the operation ought not to be delayed, and that as soon as he sees that the disease is fully established, and that it is increasing, he should recollect that delay is dangerous, and that if the operation be performed early, there is no peculiar reason to dread an unfavourable issue. Repeated* instances of

* See Hodgson on Diseases of Arteries and Veins, *pages* 116 and 345.

obliteration of the subclavian artery during life, have proved, that collateral circulation can be fully established by the numerous anastomoses that exist around the shoulder: and the experiment in the dead subject of injecting the superior extremity, after the main artery has been tied, fully demonstrates so free a communication between the vessels of the neck and arm, that all apprehension of gangrene from want of blood, may be now dismissed. Neither are there any local circumstances in the relations of this artery, or in the manner of its branching, which can lead us to suspect that the application of a ligature around it should cause the sloughing or ulceration of its coats more certainly than of any other artery of equal dimensions, there being sufficient space for the formation of an internal coagulum, admitting even that the formation of such is necessary to secure the adhesive process in an artery.

The subclavian artery may be tied on either side of the neck during life, after it has passed the scaleni muscles, with great facility, provided the clavicle have suffered no displacement. A ligature can also be passed around the right subclavian artery before it arrives at the scaleni muscles: this operation I shall denominate the internal operation of tying the right subclavian artery, in contradistinction to tying the artery after it has passed the scaleni, which may be named the external operation, and which may be performed with equal ease on either side of the neck. I shall first detail the steps of this external operation, the object of which is to enable the surgeon to pass a ligature around the subclavian artery in the third stage of

its course,—that is, as it lies on the first rib. The patient should be placed upon a table, in a horizontal position, with the arm and shoulder depressed as much as the circumstances of the case will permit; the surgeon is then to divide the integuments immediately above the clavicle from the external edge of the sterno-mastoid muscle to the anterior margin of the trapezius (in some cases the edges of these muscles are almost united, it will then be necessary to cut a few of their fibres); the edges of this incision being separated, the platisma-myoides and cervical fascia are to be divided on a director to the same extent; the external jugular vein will then be seen, and so close to the mastoid muscle, that I should recommend its being pressed towards the tracheal side of the wound; in some cases, however, the vein lies more outwardly, and may be drawn towards the trapezius muscle; a quantity of loose cellular membrane is next to be cautiously torn through with the blunt extremity of the director, the omo-hyoid muscle will then be observed at the lower part of the wound, ascending obliquely from the clavicle to the mastoid muscle, and forming the acromial side of the small triangular space before described; this muscle sometimes lies very close to the clavicle, and must be drawn upwards and outwards towards the trapezius, or, if deemed necessary, it may be divided. The surgeon should next tear with his nail, or with the end of the director, the thin fascia which lies behind the omo-hyoid, and which is connected to the scalenus muscle; the acromial edge of the latter muscle may then be seen or felt, and by passing the finger along this to the rib,

the subclavian artery will be distinguished either by its pulsation, or by its peculiar feel. The aneurism needle may then be passed around it, and by directing the point of this instrument from below and from before, upwards and backwards, the vein will be secured from injury, and the nerves are so distinct, that they may be easily avoided. The prominence of the clavicle will sometimes prevent the needle being passed from before backward, the surgeon must then introduce it from above and from behind, and in passing it round the artery, should take care not to injure the subclavian vein, or some of those veins that are in its vicinity.

These veins have been found, in some cases, productive of great inconvenience to the operator; they are sometimes very large, and when wounded, bleed profusely; they lie very deep, and cannot be secured without much difficulty. MR. LIZARS, *in the System of Anatomical Plates*, Part II. p. 70, suggests that a tourniquet applied on the arm may have the effect of diminishing the size of the subclavian vein; but the most troublesome veins in this operation arise from the shoulder and side of the neck, and cannot be affected by compressing the vessels of the arm.*

* Although the student should practise tying the principal arteries on the dead subject, yet from the facility with which this may be done, he is apt to receive erroneous impressions as to the simplicity and ease of such operations on the living. In the dead subject, when the arteries are injected, they appear prominent and distinct, while the large veins are flaccid and the small ones empty. I should recommend the surgeon, previous to attempt-

If the relation of the different parts to the artery be not changed by the disease, there is no difficulty in performing this operation, and a ligature may be passed round the artery, and tied with great facility; but should the clavicle have been much raised by the aneurismal tumour, the case will be different, the vessel will then appear at the bottom of a deep and narrow cavity, and the surrounding parts may have become so altered in structure and appearance, that considerable difficulty will exist in distinguishing between these, as well as in passing the needle around the artery, and tying the ligature at such a depth from the surface.

I cannot depict these changes more strongly, nor describe the difficulties of the operation, in such a case, more accurately, than by quoting the following extract from the account of a late case of this kind, in which the operation was performed on the right side by the late Mr. Todd, one of the Professors of Anatomy and Surgery to the College of Surgeons, to whose judgment and decision, evinced in the different steps of this embarrassing operation, this interesting case owed its ultimate recovery:

"The aneurism not only distended the axilla, so as

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ing any operation on the large arteries during life, to perform it, if possible, on the dead subject, having first injected the veins minutely, but not the arteries; he will then have the vessels in a condition somewhat similar to their living state, when the veins are found distended, while the arteries appear small and almost empty, or pulsate very feebly.

to cause the scapula to project considerably backwards, but as it was particularly prominent anteriorly, its base extending upwards to the clavicle, which was much elevated, inwards to the edge of the sternum, downwards to the nipple of the breast, and on the side of the thorax to the upper edge of the sixth rib. The tumour was tense, elastic, and pulsating; the entire limb was œdematous, and the elbow was separated to a great distance from the side. The joints of the wrist and fingers were remarkably loose; the muscles of the fore arm and hand were completely powerless. No pulsation could be felt in the radial or ulnar arteries of the diseased limb, and it had not sustained any remarkable alteration of temperature." In describing the operation, after dividing the integuments, Mr. Todd says, "dividing the platisma-myoides, fascia, and subjacent cellular tissue, occupied a considerable time, in consequence of the number of veins which it was found necessary to secure with ligatures. The external jugular and two or three other superficial veins were easily secured, but a series of more deeply seated veins proved extremely troublesome; the venous hæmorrhage having been at last effectually compressed, I proceeded to search for the omo-hyoid muscle; so much, however, was the relation of parts altered by the magnitude of the tumour, and consequent elevation of the clavicle, that this muscle was situated an inch below this bone, and it was found necessary to draw it up from its concealment, and to cut it across, that the subjacent parts might become accessible. Having applied my finger to the edge of the

scalenus anticus, I was directed by it to the situation of the artery; but at this juncture causes of further difficulty arose, chiefly from the great depth of the wound, and the doubt which the almost total absence of pulsation in the artery naturally excited in regard to its identity. The depth of the wound rendered it impossible to see to the bottom of it; I at length, however, succeeded in compressing the vessel between my fingers, when the pulsation of the tumour immediately ceased, returning when the pressure was discontinued. I directed the needle along the margin of the scalenus, and then insinuated the point of it under the artery from behind, guarding the vein with the fore finger of my left hand, until the point of the needle was sufficiently elevated; I was then enabled to seize the ligature with my fingers, the needle was then withdrawn, and the knot tied; a sufficient tightness was insured by the ends of the ligature having been passed in the ordinary way through the serre-nœud."—See *Dublin Hospital Reports*, vol. III. p. 466.

In the 78th number of the Edinburgh Medical and Surgical Journal, is an account of a case of subclavian aneurism on the left side, in which the operation was successfully performed by Mr. Wishart, who mentions that the success of the operation, and the short time in which it was performed, may be abscribed to the method employed, viz.: after making the external incision, and dividing the platisma-myoides muscle, the laying aside the knife and using the fingers in separating the cellular substance, so as to expose the artery.

No difficulty was met with in passing the ligature, or in drawing it sufficiently tight with the fingers.

From these, as well as from many other satisfactory cases of operation for the cure of subclavian aneurism, the accounts of which may be found scattered through the periodical publications of the present day, there can be no doubt as to what is the proper course to pursue in the treatment of this disease; I cannot, therefore, coincide with Mr. Shaw, who conceives, that the question of what ought to be done in common cases of axillary or subclavian aneurism, is still open, and merely hints to the student, to inquire into the propriety of the proposal to remove the arm.—See *Manual of Anatomy*, vol. i. p. 337.

The right subclavian artery may be tied on the tracheal side of the anterior scalenus muscle; this operation, which I have named the *internal* one, may be required in cases of aneurism of the axillary or subclavian artery, extending so close to the scalenus muscle, that there is not sufficient space to pass a ligature around the artery, between the disease and the acromial edge of that muscle; this operation may also be required in cases of wounds, or of secondary hæmorrhage occurring after the external operation. The internal operation may be performed in the following manner: the patient being placed upon a table, in a horizontal position, with the neck extended, divide the integuments to the extent of about three inches immediately above the clavicle, and parallel to the clavicular attachment of the sterno-mastoid muscle, beneath which insinuate a director, and detach

the fibres of this muscle from the bone, then tear through some cellular membrane and separate some small arteries and veins, some of which may require a ligature: the sterno-hyoid and thyroid muscles being thus exposed, are next to be divided on a director first cautiously passed behind them; the internal jugular vein is then seen resting on the scalenus anticus, and the subclavian artery may be observed between this vein and the carotid artery, with the vagus nerve descending anterior to it, and sending its recurrent behind it; the vein should then be drawn or pressed outwards by a broad retractor, and the vagus drawn inwards towards the carotid with a blunt hook; the aneurism needle may then be passed round the subclaxian artery, and by directing it from below upwards, the right vena innominata and pleura will be less endangered than by giving it a contrary direction. The ligature should be tied as near the vertebral artery as possible, and thus a sufficient space will be left for an internal coagulum to form between the ligature and the origin of the carotid. In tying the ligature, the operator should endeavour to avoid including the branches of the sympathetic nerve, which form a plexus round the subclavian and vertebral arteries.

This operation of tying the right subclavian artery on the tracheal side of the scalenus muscle, was first performed in Steevens's Hospital, in the year 1813, by Dr. Colles, one of the Professors of Anatomy and Surgery to the College of Surgeons. The result of this case was unfavourable, as have been the first attempts in most of the principal operations on the

larger arteries. Indeed the history of surgery presents a singular coincidence in this respect; Hunter, Abernethy, Cooper, and Colles, have been all at first unfortunate in their operations on the large arteries, and success has failed to attend their efforts until after repeated trials, although fully as much dexterity and judgment appear to have been evinced in the former as in the latter. From the account of this case, however, we may deduce not only the practicability of the operation, but we may also infer, that no sudden dangerous effects are produced on the constitution by tying so large an artery in the vicinity of the heart: this case also, in addition to many others, proves, that the free anastomoses between the cervical and brachial arteries, can transmit a sufficient supply of blood to the superior extremity, although the subclavian be tied before it gives off any branch. After accurately describing all the particulars of this and of two cases of axillary aneurism, Dr. Colles makes the following judicious observations, the value of which the surgical anatomist will fully appreciate, not merely in his study, but in the dissecting-room, when he contrasts the right and left subclavian arteries in the first stages of their course:—

"To lay bare the right subclavian artery before it reaches the scaleni, will not be found difficult by any surgeon possessed of a steady hand and a competent knowledge of anatomy; but I fear, that with the utmost dexterity, much difficulty will be experienced in passing and tying the ligature around it, even in the most favourable case. This operation, difficult on the

right, must be deemed impracticable on the left subclavian artery, for the great depth from the surface at which this vessel is placed, the direct course which it runs in ascending to the top of the pleura, the sudden descent which it makes from this to sink under the clavicle, and the danger of including in the same ligature the eighth pair of nerves, the internal jugular vein, or the carotid artery, which all run close to, and nearly parallel with this artery; these all constitute such a combination of difficulties, as must deter the most enterprising surgeon from undertaking this operation on the left side."—See *Edinburgh Medical and Surgical Journal*, No. 41, vol. II.

In describing the operation of tying the subclavian artery, I have as yet taken no notice of the proposals of dividing the clavicle and subclavian muscle, for the purpose of exposing the artery as it lies on the first rib, or of dividing the scalenus anticus in order to tie it in the middle division of its course. As to the former, I cannot conceive any case which could justify so violent a proceeding as to saw through the clavicle and divaricate the extremities of the bone to expose the artery; under the most unfavourable circumstances, I should prefer attempting either the external or internal operation, to having recourse to so objectionable a measure. As to dividing the scalenus anticus, in order to tie the artery in its middle stage, although I have had no experience of this mode of performing the operation, yet it appears to me open to strong objections on anatomical principles: in dividing this muscle, the internal jugular vein is in great

danger of being wounded, the phrenic nerve also can scarcely escape; this nerve, though generally near the tracheal edge, yet I have often observed it nearer the acromial margin of this muscle; what the consequences of dividing this nerve might be, I cannot venture to assert, but I think it more than probable that this accident would produce effects very alarming and unfavourable to the recovery of the patient after an operation from which more or less dyspnœa and disturbance in the general circulation are to be apprehended; the artery is also in very close contact with the pleura in this division of its course, and immediately internal to this point, it sends off its principal branches, the proximity of which may perhaps serve as an additional objection to this mode of performing the operation, were any further necessary against a measure which has nothing peculiar to recommend it, though no doubt it can be performed without much difficulty.

The student may now proceed to dissect the branches of the subclavian arteries; these are in general similar on the right and left sides, but no other arteries in the body present a greater variety in the number and order of their branches; so uncertain are they in this respect, that seldom will any description be found exactly to correspond with nature. The principal branches, however, of each subclavian artery, are five in number, three of which are given off in the first stage of its course, namely the arteria vertebralis, axis thyroideus, and arteria mammaria interna; the remaining two arise from the middle division

of the subclavian artery, these are the arteria intercostalis superior, and cervicalis profunda. The subclavian artery in its third stage gives off no regular branch; sometimes, however, the supra-scapular artery, and the posterior artery of the scapula, (both of which are usually branches of the thyroid axis,) arise in this situation; the cervicalis superficialis also, which is generally a small branch of the transversalis colli, sometimes arises from the third division of the subclavian artery.

I.

ARTERIA VERTEBRALIS,

Is always the largest, but not uniformly the first branch of the subclavian artery; it arises from its upper and posterior part; (on the left side it frequently arises from the arch of the aorta between the left carotid and left subclavian arteries;) it immediately ascends, inclining a little outwards and backwards, and between the scaleni and longus colli muscles enters the foramen in the transverse process of the sixth or fifth cervical vertebra, sometimes that of the seventh or fourth. The vertebral artery then ascends through the succession of foramina in the transverse processes of the cervical vertebræ, and having passed through that in the second vertebra, it inclines outwards and upwards, making a remarkable curvature to reach the foramen in the transverse process of the atlas; it then bends backwards almost horizontally behind the occipi-

to-atlantal articulation, runs in a deep groove on the upper surface of the atlas, and perforates the posterior broad ligament beneath the sub-occipital nerve; the vertebral artery then runs forwards and upwards through the foramen magnum, to the lower edge of the pons varolii, where it joins the vertebral artery from the opposite side, and thus, by the confluence of these two vessels, the great basilar artery is formed. The vertebral artery should be first examined in the neck, afterwards within the cranium; its origin from the subclavian artery is covered by the superficial muscles of the neck, the internal jugular vein, and the inferior thyroid artery; it is enveloped in the inferior cervical plexus of the sympathetic nerve; the phrenic nerve and anterior scalenus muscle are on its acromial side, the vagus nerve and longus colli muscle lie to its inner or tracheal side. The vertebral artery, in its cervical course, gives off no particular branch; it sends a few arteries only to the deep muscles which are attached to the transverse processes; between the atlas and occipital bone it sends off some large branches to supply the muscles at the upper and back part of the neck; these anastomose with the arteria occipitalis and cervicalis profunda. As the vertebral artery ascends through the transverse processes, it lies anterior to the cervical nerves, along each of which it sends small branches into the medulla spinalis, which anastomose with the other arteries of that organ. The vertebral artery, in passing forwards from the atlas to the cuneiform process, sends off several branches to the dura mater and nerves in this situation: it also, in

this part of its course, generally gives off the arteria cerebelli inferior, and the arteriæ medullæ spinalis anterior et posterior.

1. ARTERIA CEREBELLI INFERIOR VEL POSTERIOR. This artery, although in general described as arising from the vertebral, yet often proceeds from the trunk of the basilar, it frequently arises by two branches; it runs in a very tortuous manner backwards and downwards, gives large branches to the inferior surface of the cerebellum, then continues backwards, between the vagus and spinal accessory nerves, sends small branches to the origin of these, and having arrived at the posterior fissure of the cerebellum, where it is remarkably contorted, it divides into several branches which ramify on the pia mater, investing the inferior and posterior part of this organ; some may be traced into the choroid plexus of the fourth ventricle, and others as far as the circumference of each hemisphere, where they anastomose with the superior arteries of the cerebellum.

2, 3. ARTERIÆ MEDULLÆ SPINALIS POSTERIOR ET ANTERIOR. These are small and delicate arteries, remarkable for their length, their tortuosity, and their free and frequent inosculations with each other, and with branches from different parts of the arterial system in the cervical, dorsal and lumbar regions. The posterior spinal arteries are generally two in number; each arises either from the vertebral artery, or from the branch last described; they first incline backwards to the posterior surface of the spinal marrow, and then descend nearly parallel to each other;

if minutely injected, or if distended with blood, they may be traced as far as the lumbar region; their branches are very small, and anastomose with each other, and with the small arteries which enter the intervertebral foramina along with the different nerves.

The anterior spinal arteries are not so large as the posterior; each arises from the vertebral artery near the commencement of the basilar, and descends along the anterior surface of the medulla spinalis; they soon unite with each other, and form one tortuous vessel, which descends to the inferior extremity of the medulla spinalis: throughout this course it is constantly sending branches to either side, which unite with the posterior spinal arteries, and with those which have entered the intervertebral foramina.

ARTERIA BASILARIS.

Near the inferior extremity of the pons varolii, and between the origins of the lingual nerves, the two vertebral arteries converge, and from their union the basilar proceeds. This artery is seen most satisfactorily by removing the brain from the cranium, as was recommended in the description of the internal carotid, (page 84). The basilar artery derives its name from the basilar or cuneiform process of the occipital bone, on which it runs, from the anterior edge of the foramen magnum to the posterior clinoid processes of the sphenoid bone: it is about the same size as the internal carotid after the origin of the ophthalmic. In this course it is covered and connected by the arach-

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noid membrane in a groove on the surface of the tuber annulare or commissura cerebelli, at the superior extremity of which it divides into four branches, two for the cerebrum, and two for the cerebellum: as the basilar artery ascends in this groove, it gives numerous small branches to the pia mater on either side, several of which enter the substance of the tuber. The basilar artery, at its commencement, separates the sixth or abducentes nerves of opposite sides, and between its terminating branches at the upper edge of the tuber annulare, arise the third pair, or motores oculorum.

The terminating branches of the basilar artery are four, two to either side, namely, the arteria cerebelli anterior, and arteria cerebri posterior.

1. Arteria cerebelli anterior vel superior. This artery passes outwards and backwards around the upper part of the tuber annulare, and arrives at the superior surface of the cerebellum; it first sends several branches to the pia mater connected to the tubercula quadragemina, to the pineal gland, and to the velum interpositum; it also sends a small but very tortuous artery to the meatus auditorius internus, which separates the portio dura and portio mollis of the seventh pair of nerves; this auditory branch sometimes arises from the basilar, it is constantly present but is very uncertain as to its origin. The superior artery of the cerebellum then divides into long, delicate, and tortuous branches, which, after minute subdivisions, are distributed to the pia mater, covering the convolutions of the cerebellum. This artery, in

the first part of its course, is parallel to the trochlearis or fourth nerve.

2. ARTERIA CEREBRI POSTERIOR is the termination of the basilar artery, and is larger than the last described branch; it passes outwards and backwards round the crus cerebri, and arrives at the inferior surface of the posterior lobe of the cerebrum; it there divides into several branches, which are distributed to the pia mater in the same manner as are the other arteries of the brain: this artery, at its commencement, is separated from that last described, by the origin of the third or motor oculi nerve. Each posterior cerebral artery receives the posterior communicating branch from the internal carotid, and thus these vessels complete the anastomosis of Willis, which, although commonly described as a circle, yet is rather a quadrangle; it is formed in front by the anterior arteries of the cerebrum, and their communicating branch, laterally by each internal carotid and its posterior communicating branch, and behind by the trunk of the basilar, and the posterior cerebral arteries; within this anastomosis are situated the infundibulum, corpora albicantia, tuber cinereum, and the locus perforatus medius.

Thus is the brain supplied with blood; four arteries, remarkable for their free communication with each other, not by small branches, but by large vessels, lie at the base of this organ, between it and the bones of the cranium; the force of the circulation in these vessels is therefore imparted to this tender viscus, producing upon it a lively impression, or, as Bichat ex-

presses it, an excitement necessary for the performance of its functions. The ingenious and original remarks of this physiologist, contained in the second part of "*Recherches Physiologiques sur la Vie et la Mort*," are well worthy the attention of him who wishes to combine the study of anatomy and physiology in their natural and legitimate connexion.

The internal carotid and vertebral arteries resemble each other in many respects; they both lie deep in the neck, the carotid being covered by several muscles, and the vertebral inclosed in a canal formed in part by bone, and in part by muscles: both the carotid and vertebral arteries are very tortuous, and both form remarkable curvatures as they are entering the cranium; these have been long considered as a natural design to retard the course of the circulation, or to diminish the force of the heart in these vessels before they reach the brain; this opinion could admit of no doubt were the arteries filled and emptied alternately with the systole and diastole of the heart; but this is not the case; the arteries, as Bichat observes, are always full of blood, the motion communicated to this fluid cannot, therefore, be affected by any curvature, and must be felt as sensibly at the remote extremities of the vessels, as at their origin.* Mr. Charles Bell has very ingeniously endeavoured to prove, from a number of observations on the curvature of arteries, and on the changes which they undergo, that the natural

* Anatomie Descriptive, tom. iv. p. 202.

design of curvatures on any vessel, is to increase its power and capacity; that the more tortuous any artery is, the more active it becomes; and that an artery, in proportion to its tortuosity, becomes less dependent on the force of the blood transmitted from the heart, and more on the excitement of the organ which it serves.*

From the number and size of the inosculating branches of the arteries which supply the brain, no interruption can possibly occur in the cerebral circulation from any obstruction in one or more of the primary vessels in the neck. All the cerebral arteries terminate on the brain in a similar manner; they divide as minutely as if entering a secreting or a glandular organ; these subdivisions take place not on the arachnoid or serous membrane, but on the pia mater, on which they form numerous circles of anastomosis: these small vessels then enter the substance of the brain; some cannot be traced farther than the cineritious substance; others very fine and long pass into the medullary or fibrous part of the brain, and can be drawn out like long threads, not having much connexion to the parts around them.

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* An Essay on the Forces which circulate the Blood.—Lond. 1819.

II.

ARTERIA MAMMARIA INTERNA.

This is a large and very regular branch, it arises from the lower part of the subclavian artery opposite the vertebral; it sometimes arises from the thyroid axis, or from the innominata, or from the arch of the aorta; its course is first forwards, and then downwards into the thorax, and through this cavity close to the internal surface of the cartilages of the ribs near their sternal extremity, between the triangularis sterni and intercostal muscles, and terminates in the abdominal muscles. This artery may be exposed either by everting the sternum, together with the cartilages of the ribs, or, in a young subject, a neater dissection of this artery may be made, by carefully raising the sternum and costal cartilages from the artery, so as to leave it connected to the pleura. As the mammary artery enters the thorax, the phrenic nerve crosses anterior to it, and then descends on its inner side; like all arteries of the same size, it is accompanied by two veins. In this course, the mammary artery gives off several branches externally to the intercostal spaces, internally to the anterior mediastinum, and at the xyphoid cartilage divides into two terminating branches. The branches of this artery are named from the parts they are destined to supply; these are the intercostal muscles, mediastinum, pericardium, diaphragm, &c.

1. ARTERIÆ INTERCOSTALES ANTERIORES. A each of the five superior intercostal spaces, a branch passes outwards from the mammary artery, and runs at first between the pleura and the internal intercostal muscle, but it soon passes between the laminæ of these muscles; each of these arteries divides into two branches, which run along the opposite edges of the ribs, and inosculate so freely with the posterior intercostal arteries from the aorta, that it is difficult to mark any distinction between them: they send several branches through the intercostal spaces to the muscles and integuments on the front of the thorax; in the female some of these branches are very large, and enter the mammary gland; others anastomose with the thoracic arteries from the axillary; occasionally some of these cutaneous branches are found very large, and may be traced to a considerable distance on the parietes of the thorax. The mammary artery sends internally,

2. ARTERIÆ MEDIASTINI. Under the head of arteries of the mediastinum, we may class those fasciculi of branches which are sent to the adipose membrane which occupies the situation the thymus gland formerly held, and also the branches to the sterno-hyoid and thyroid muscles, to the trachea, the bronchi and adjacent lymphatic glands, to the pericardium, pleura, diaphragm, and triangularis sterni muscle. In the fœtus a very large branch, or even several, may be observed to pass into the thymus gland; these may be named the thymic arteries.

3. ARTERIA COMES NERVI PHRENICI, or the su-

perior diaphragmatic artery, arises from the internal mammary near the upper part of the mediastinum; though small it continues its tortuous course along the side of the pericardium to the diaphragm, assists in supplying this muscle, and anastomoses with the proper phrenic arteries. Posterior to the cartilage of the sixth rib, the mammary artery terminates by dividing into two branches.

4. Arteria musculo-phrenica passes obliquely downwards and outwards, along the margin of the hypochondriac region, close to the attachment of the diaphragm; it sends a branch externally to each of the inferior intercostal spaces, and several internally to the diaphragm.

5. Ramus abdominalis is the last branch of the mammary artery; it sends small twigs towards the xyphoid cartilage, which anastomose with those of the opposite side: this branch then descends between the peritoneum and abdominal muscles, and ends in several long and tortuous arteries which supply the abdominal muscles; in the recti they inosculate with the epigastric, and in the transverse with the intercostal, the lumbar, and the circumflexa ilii arteries.

The mammary arteries are remarkable for the number of their inosculations, and for the distant parts of the arterial system which they serve to connect: they anastomose with each other, and their inosculations with the thoracic aorta encircle the thorax: on the parietes of this cavity their branches connect the axillary and subclavian arteries; on the diaphragm they

form a link in the chain of inosculations between the subclavian artery and abdominal aorta, and in the parietes of the abdomen they form an anastomosis most remarkable for the distance between those vessels which it serves to connect, namely, the arteries of the superior and inferior extremities.

III.

AXIS THYROIDEUS,

Arises from the upper part of the subclavian artery opposite to the mammary, and at the inner edge of the scalenus anticus; it is larger in proportion in the infant than in the adult, it inclines forwards and upwards, but almost immediately divides into four branches, two of which ascend, and two run transversely towards the trapezius muscle: the ascending branches may be named the arteria thyroidea inferior, and the cervicalis ascendens; the two transverse branches are the arteria transversalis colli and the transversalis humeri, or supra-scapularis: it sometimes gives off the internal mammary.

1. Arteria thyroidea inferior vel ascendens is the largest branch of the thyroid axis; is very tortuous, runs upwards and inwards over the longus colli muscle, behind the carotid artery, jugular vein, vagus, and sympathetic nerves; on the left side it is posterior to the thoracic duct; it is accompanied by and lies posterior to the recurrent nerve. After several contortions it arrives at the side of the trachea,

sends several branches to that tube, also to the phagus; it then bends in different directions, re the thyroid body, divides into two large bra which pass to the posterior surface of its lateral and divide into numerous branches to supply th gan; these keep up a free anastomosis with the rior thyroid artery from the external carotid with the inferior thyroid artery of the opposit When the middle thyroid artery is present, th ferior thyroid on one or both sides will be found small.

2. ARTERIA CERVICALIS ASCENDENS: this l sometimes arises from that last described, and no the axis; it is in general a small artery; it a on the scalenus and rectus capitis lateralis m parallel to the phrenic nerve; its branches are buted to the deep-seated muscles on the fron sides of the vertebræ; small twigs accompany th vical nerves through the intervertebral foramin anastomose with the vertebral and spinal ar some branches also unite with arteries desc from the occipital artery.

3. ARTERIA SUPRASCAPULARIS VEL T VERSALIS HUMERI, is nearly as large as the i thyroid; it passes across the neck, descending a so as to lie somewhat behind the clavicle, and i nected to the subclavian vein and muscle by fascia; it crosses the scalenus muscle, subclav tery, and phrenic nerve, and runs along the t the triangular space before described: when the has arrived at the notch in the superior costa

scapula, it enters the supra-spinal fossa more generally above, but sometimes below the ligament that converts that notch into a foramen, sinks between the supra spinatus muscle and the bone, in this fossa it divides into two branches, which may be named, from their course and termination, the supra and infra-spinal arteries. As the supra-scapular artery is passing across the neck it sends several recurrent branches to the cellular membrane behind the sterno-mastoid muscle; some of these pass between the two portions of this muscle to the integuments on the thorax, and some supply the sterno-clavicular articulation: the supra-scapular artery frequently arises from the subclavian, either in its first or in its last stage; it also often arises from a trunk common to it and the transversalis colli, or the internal mammary artery.

When the supra-scapular artery has arrived near the superior costa of the scapula, it sends off,

1. *Arteria acromialis superior.* This branch runs downwards, forwards, and outwards; it generally perforates the clavicular portion of the trapezius, but sometimes passes out anterior to this muscle: it then ramifies on the superior aspect of the acromion process, distributing its branches to the trapezius and deltoid muscles, and inosculating with the arteria thoracica-acromialis, subscapularis, and profunda superior.

The supra-scapular artery also sends off several small branches, which ascend, and inosculate with the transversalis colli, and with branches from the occipital artery: in a well injected subject, the inosculations

between the supra-scapular, transversalis colli, andoccipital arteries, behind the trapezius muscle, appear numerous and free, and form a complicated net-work, which causes some embarrassment to the dissector: from a careful dissection of these vessels, however, the student may infer that their inosculations will be competent to afford an ample supply of blood to the superior extremity, in case the principal artery of the limb has been obliterated. When the supra-scapular artery has arrived at the notch or foramen in the superior costa of the scapula, it gives off several small branches to the muscles in the vicinity, namely, to the trapezius, serratus magnus, levator anguli scapulæ, &c.; and having entered the supra-spinal space, it divides into its terminating branches.

2. *Arteria supra-spinalis*, supplies the supra-spinatus muscle; it sends some branches through the substance of this muscle to the posterior angle of the scapula: some of these lie close to the bone, while others accompany the fibres of the muscle towards the shoulder articulation, supply the capsular ligament, and inosculate with the circumflex or articular arteries.

3. *Arteria infra-spinalis*. This artery, in size, appears the continuation of the supra-scapular; it descends beneath the acromion, and behind the glenoid cavity, to the infra-spinal space, where it divides into several branches: some of these supply the infra-spinatus and teres minor muscles, others pass towards the base of the scapula, and inosculate with the posterior scapular artery, and others descend close to the

bone to the inferior costa, and inosculate very freely with the subscapular.

4. ARTERIA TRANSVERSALIS COLLI. This is the last, and largest branch of the thyroid axis: it often arises from the subclavian, and is next in size to the vertebral and internal mammary arteries. Like the last described artery it passes outwards, but at some distance above it, and crossing the scalenus anticus, and brachial plexus of nerves between the sterno-mastoid and trapezius muscles, it divides into two principal branches, viz., the arteria cervicalis superficialis, and arteria scapularis posterior: before thus dividing it gives off several small branches to the deep-seated muscles, nerves, and glands, in this region.

1. *Arteria cervicalis superficialis.* This artery, as its name implies, is distributed to the integuments and fascia of the neck, also to the lymphatic glands, and to the cervical plexus of nerves situated between the mastoid and trapezius muscles: to these muscles it gives several branches; and beneath the trapezius it divides into long and delicate branches, some of which ascend to meet the descending branches from the occipital artery, and to assist in supplying the muscles on the back of the neck, while others descend towards the acromion and spine of the scapula, and inosculate with the supra-scapular artery.

2. *Arteria scapularis posterior* in general appears the continued trunk of the transversalis colli, but frequently it arises distinctly from the trunk of the subclavian artery external to the scaleni muscles; it is al-

sends several branches to that tube, also to the œsophagus; it then bends in different directions, reaches the thyroid body, divides into two large branches which pass to the posterior surface of its lateral lobes, and divide into numerous branches to supply this organ; these keep up a free anastomosis with the superior thyroid artery from the external carotid, and with the inferior thyroid artery of the opposite side. When the middle thyroid artery is present, the inferior thyroid on one or both sides will be found very small.

2. ARTERIA CERVICALIS ASCENDENS: this branch sometimes arises from that last described, and not from the axis; it is in general a small artery; it ascends on the scalenus and rectus capitis lateralis muscles, parallel to the phrenic nerve; its branches are distributed to the deep-seated muscles on the front and sides of the vertebræ; small twigs accompany the cervical nerves through the intervertebral foramina, and anastomose with the vertebral and spinal arteries; some branches also unite with arteries descending from the occipital artery.

3. ARTERIA SUPRASCAPULARIS VEL TRANSVERSALIS HUMERI, is nearly as large as the inferior thyroid; it passes across the neck, descending a little, so as to lie somewhat behind the clavicle, and is connected to the subclavian vein and muscle by a thin fascia; it crosses the scalenus muscle, subclavian artery, and phrenic nerve, and runs along the base of the triangular space before described: when the artery has arrived at the notch in the superior costa of the

scapula, it enters the supra-spinal fossa more generally above, but sometimes below the ligament that converts that notch into a foramen, sinks between the supra spinatus muscle and the bone, in this fossa it divides into two branches, which may be named, from their course and termination, the supra and infra-spinal arteries. As the supra-scapular artery is passing across the neck it sends several recurrent branches to the cellular membrane behind the sterno-mastoid muscle; some of these pass between the two portions of this muscle to the integuments on the thorax, and some supply the sterno-clavicular articulation: the supra-scapular artery frequently arises from the subclavian, either in its first or in its last stage; it also often arises from a trunk common to it and the transversalis colli, or the internal mammary artery.

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2. *Arteria supra-spinalis*, supplies the supra-spinatus muscle; it sends some branches through the substance of this muscle to the posterior angle of the scapula: some of these lie close to the bone, while others accompany the fibres of the muscle towards the shoulder articulation, supply the capsular ligament and inosculate with the circumflex or articular arteries.

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2. *Arteria scapularis posterior* in general appears the continued trunk of the transversalis colli, but frequently it arises distinctly from the trunk of the subclavian artery external to the scaleni muscles; it is al-

ways present, but its origin is very irregular, it sometimes proceeds from the axillary. To expose this artery, the trapezius and rhomboid muscles must be partially divided, and some adipose and cellular membrane carefully removed, and the shoulder drawn forward: it may be then observed, turning round the side of the neck behind the levator anguli scapulæ muscle, towards the posterior angle of the scapula; it next bends downwards, and runs in a vertical direction along the base of the scapula, as far as the inferior angle of that bone; in this part of its course it is covered by the rhomboid muscles, beneath which it divides into two or three branches, one of which descends close to the base of the scapula, the others pursue a parallel course nearer the vertebræ: long transverse branches are given off from these to the rhomboid, latissimus dorsi, and trapezius muscles, some pass to the integuments, and others sink deep to the extensor muscles of the spine, inosculating with the posterior branches of the intercostal arteries. The continuation of the posterior scapular artery may be traced to the inferior angle of the scapula, where it divides into several branches, some of which are distributed to the latissimus dorsi, teres major, and serratus magnus muscles, and others pass inwards towards the axilla, and anastomose very freely with the subscapular artery.

The three margins of the scapula are thus bordered by arteries, the supra-scapular being somewhat parallel to the superior costa, the posterior scapular to the base, and the sub-scapular corresponding to the infe-

rior costa of this bone: these three arteries form a chain of inosculations around the scapula, which must be of essential service in conveying blood from the subclavian artery to the axillary, when the former has been obliterated in the third stage of its course.

When the subclavian artery has entered its middle stage, it gives off its two last branches, namely, the deep cervical, and superior intercostal.

IV.

ARTERIA CERVICALIS PROFUNDA.

This artery lies deeply concealed, both at its origin and throughout its whole course; it frequently arises in common with the superior intercostal, and sometimes from the vertebral; it first runs upwards, outwards, and backwards, sunk between the transverse processes of the sixth and seventh cervical vertebræ, and between the branches of the brachial plexus of nerves; it then ascends on the posterior surface of the cervical vertebræ between the spinous and transverse processes, lying close to the bones, and giving off numerous branches to the deep-seated muscles on either side; near the occipital bone it inosculates with the vertebral artery, and with the deep descending branches from the occipital.

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V.

ARTERIA INTERCOSTALIS SUPERIOR,

Arises close to the last described branch from the lower part of the subclavian artery; it immediately descends in front of the neck of the first rib, external to the first thoracic ganglion of the sympathetic nerve; at the first intercostal space it sends a branch, which runs, like the other intercostal arteries, between the muscles, supplies these, and sends some branches to the integuments, and to the pleura; the superior intercostal artery then descends in front of the neck of the second rib, and supplies the second intercostal space in a manner similar to the first; but sometimes, particularly on the right side, a branch is continued in front of the third rib to the third intercostal space. A small branch always connects the superior intercostal artery to the first intercostal from the thoracic aorta.

The subclavian artery, in the third division of its course, gives off no regular branch, though very frequently some of those arteries, which I have described as arising from the thyroid axis, will be found to take their origin from it. The transversalis colli, which is the third branch of the thyroid axis, and which, when regular, divides into the superficial cervical and posterior scapular, is sometimes a small branch, and ends in

the superficial cervical; in such cases, the posterior scapular artery will usually be found to arise distinctly from the subclavian on the external side of the scaleni muscles; it will then pass between some of the nerves of the brachial plexus, and pursuing its tortuous course towards the superior angle of the scapula, it may be traced along the base of that bone.

In some subjects, the supra-scapular also will arise from the external part of the subclavian artery, and not from the thyroid axis; and sometimes the supra and posterior scapular will arise by a common trunk. From the subclavian a small branch often proceeds, and takes the course of the superficial cervical when the transversalis colli has been absent; occasionally small branches arise from this division of the subclavian artery, which deserve no particular description or name: they are distributed to the brachial plexus, to the scaleni, and deep-seated muscles on the side of the neck; some also pass to the cellular tissue and glands in the axilla and to the serratus magnus muscle.

The most regular branches of the subclavian artery, in its first stage, are the vertebral, internal mammary, and inferior thyroid; and in the second stage, the deep cervical, and superior intercostal. The arteries most subject to variety, not as to their situation, but as to their origin, are, the supra-scapular and posterior scapular arteries, the former, being, when regular, a branch of the thyroid axis, and the latter, a branch of the transversalis colli, which is also derived from the thyroid axis. Both these arteries are concerned, and

should be avoided in the external operation of the subclavian artery.

The branches of the subclavian arteries w sometimes found to vary in number and size o right and left sides of the neck.

ARTERIA AXILLARIS.

THE continuation of the subclavian artery receives this name at the inferior border of the first rib, and retains it until it arrives at the lower margin of the tendon of the latissimus dorsi, and teres major muscles. The dissection of the axillary artery is difficult, not only in consequence of the number of branches it gives off, but also from its being surrounded by the brachial plexus of nerves, and by a considerable quantity of cellular membrane containing lymphatic glands, and several arteries and veins: this dissection, however, should be made with great care, as the parts concerned are of practical importance. The student should endeavour to retain the muscles, nerves, and vessels, as much in their natural situation as possible, and those which must be displaced he should preserve in such a manner, as that he may restore them at pleasure, so as to study the relative anatomy of the different parts contained in the axilla.

The integuments and cellular membrane are first to be removed from the pectoral and anterior portion of the deltoid muscles, and from the inferior part of the axilla, as far as the latissimus dorsi and teres major muscles; the floor or base of this cavity will then be observed to be closed by a strong fascia passing from its anterior to its posterior border; this fascia descends on the ribs, and is attached externally to the muscles of the arm; (a strong band of muscular fibres some-

times connects the margins of the pectoral and latissimus dorsi;) in this fascia are distributed several small nerves, veins, and arteries: if this aponeurosis be divided in a direction from the arm to the ribs, the cavity of the axilla will be opened, and by tearing through some loose cellular membrane towards the humerus, the trunk of the axillary artery and vein will be brought into view, the latter covering the artery. Along the posterior border of the axilla, also, a large vessel may be seen; this is the sub-scapular artery, attached to which are several lymphatic glands; and along the anterior margin of the axilla there is another artery of considerable size, namely, the long thoracic or external mammary, with which also some conglobate glands are connected: if the loose cellular membrane in the middle of the axilla be now removed, a plexus of small arteries and veins will be exposed, the branches of which run in every direction to and from the conglobate glands of this region.

To this view of the axilla from below, the student should pay particular attention; for it is in this direction this cavity is to be opened in the operation of extirpating diseased glands in the living subject; from this he may learn, that there is no danger in dissecting in towards the ribs, when the arm is held apart from the body, but that if it be necessary to pursue the dissection towards the external or humeral side of the cavity, or towards its apex, the surgeon should proceed with great caution, and keep the back of the knife towards the vessels, as the axillary vein is in imminent danger; and in dissecting towards the po-

terior part of the axilla, the course and size of the sub-scapular artery and vein should be recollected. The glands most frequently diseased are those immediately behind the great pectoral muscle; in extirpating these, particularly if they lie near the ribs, no vessels of large size are endangered, the thoracic arteries alone can be wounded. Though the thoracic vessels are small, yet they bleed smartly when cut, and there is some difficulty in drawing them out of the loose cellular membrane into which their divided extremities retract: hence, in removing a tumour which has extended deep into the axilla, the surgeon is frequently obliged to pass a ligature around its base, and before he cuts it, to tie the fasciculus of vessels which are entering its substance; this proceeding, no doubt, is often productive of pain and inconvenience, and retards the healing process.

The student may now proceed with the dissection of the axillary artery from above, and should first divide the great pectoral muscle from its clavicular to its inferior edge, avoiding such large branches as may lie immediately posterior to it; the edges of this muscle being separated, and some loose cellular membrane removed, the lesser pectoral will be exposed: this muscle does not rise so high as the clavicle, therefore, between its superior edge and the subclavian muscle, the axillary artery and vein are partly exposed, a dense fascia, however, is extended over them: this fascia, in some subjects, is very strong, like a ligament, and is considered as such by some anatomists, who have given it the name of costo-coracoid, or co-

raco-clavicular ligament; it extends from the cartilage of the first rib to the coracoid process, and adheres to the clavicle and subclavian muscle between these two points; it is very strong as it passes over the axillary artery, presenting a lunated edge, which looks downwards and inwards. The lesser pectoral muscle should be next divided from above downwards, and the edges being separated, the axillary artery and vein will be exposed through their entire course; the direction in which these run depends on the relative position of the arm to the trunk: as the subject lies on the table the arm abducted so as to form a right angle with the side, the axillary artery runs outwards, backwards, and a little downwards; but if the arm be approximated to the side, the artery will be somewhat curved, the convexity towards the shoulder.

The axillary artery crosses the axilla obliquely, superiorly lying on the thoracic, and inferiorly on the humeral side of this region. For the purpose of more accurately examining its relations to the surrounding parts, the student may divide it into three portions, a superior, middle, and inferior. The superior portion of the axillary artery rests upon the first layer of intercostal muscles, and the second digitation of the serratus magnus muscle, and is covered by the clavicular part of the great pectoral muscle, and by the costo-coracoid ligament. A sharp pointed instrument passed obliquely inwards, between the deltoid and pectoral muscles, may wound this portion of the artery without dividing any muscle; the cephalic vein, and the acro-

mial thoracic artery, will, in all probability, be injured by a wound of this description.

The middle division of the axillary artery crosses the axilla, lies on, and is partly enveloped by the brachial plexus of nerves, and is covered by both pectoral muscles.

The inferior third of the axillary artery rests against the subscapular muscle (which separates it from the capsular ligament of the shoulder-joint) and the tendons of the latissimus dorsi and teres major muscles: this portion of the artery is only covered by the great pectoral muscle and the integuments.

The axillary artery is accompanied by the axillary vein and brachial plexus of nerves; in the superior third the vein is superficial to the artery and to its sternal side, the plexus of nerves is posterior, and to its acromial side; in the middle third the vein is more directly in front of the artery, and the nerves are around it, forming the axillary plexus, from which the different branches proceed to the arm; in the inferior third the vein is still superficial to the artery, and here, in general, it receives several branches from different directions. The nerves are generally related to this division of the artery in the following order: the brachial or median nerve, proceeds from the plexus by two roots, between which the artery is placed; on the humeral side of the artery are the external root of the median nerve and the external cutaneous or perforans Casserii; on its internal side are the internal root of the median, the internal cutaneous and ulnar nerves; and posterior to it are the circumflex and

musculo-spiral nerves: near the lower margin of the latissimus, the internal cutaneous and median nerves are sometimes superficial to the artery.

Before the student proceed to trace the branches of the axillary artery, he should consider in what situation this vessel may be exposed in the living subject. The proposal of compressing this artery against the second rib, I have considered, and endeavoured to refute, when describing the mode of compressing the subclavian above the clavicle; and if the student will carefully contrast these two situations in the dead subject, I have no doubt he will decide in favour of the latter, as that in which compression of the artery can be most effectually applied.

The axillary artery may be exposed in two situations, namely, at the lower and at the upper part of the axilla; in either situation a surgeon may be required to tie this artery in cases of wounds or aneurism of the upper part of the brachial artery. These operations on the axillary artery may be distinguished by the terms *inferior* and *superior;* the former can be easily performed, and is nearly similar to that of tying the brachial artery; the latter, however, is extremely difficult and dangerous, and in very few cases only ought to be preferred to the comparatively easy operation of tying the subclavian artery external to the scaleni muscles.

We shall consider the best mode of performing both of these operations; and first the inferior one, because it is attended with less difficulty and danger, and because it is more frequently necessary than the superior

operation. The axillary artery may be tied, in the inferior part of its course, in the following manner: the patient should be laid upon a bed or table, the arm separated from the side, and the hand supinated; make an incision about two inches in length, through the integuments, over the prominence of the head of the humerus, and between the tendons of the pectoralis major and latissimus dorsi, but a little nearer to the latter: by dissecting cautiously through a little cellular membrane, the median nerve and axillary vein will be exposed; the former may be drawn to the humeral, the latter to the costal side of the artery; bending the elbow will relax the nerves, and by detaching the surrounding cellular membrane with the finger, or a blunt instrument, an aneurism needle may be passed round the artery from the ulnar to the radial side. In this part of the operation every precaution must be taken to avoid injuring the veins or nerves, their relation to the arteries not being uniform: sometimes a nerve will cross the artery, and in place of one large vein, there may be two or three accompanying the artery, one on each side, and one in front.

The superior operation may be performed in the following manner: the patient may be seated, with the shoulder of the affected side inclined backwards; an assistant should be placed behind the patient, with instructions to compress the subclavian artery in the event of hæmorrhage; a semilunar incision is to be made, about three inches long, through the integuments, commencing about one inch from the sternal end of the clavicle, and extending towards the acro-

mion process as far as the anterior edge of the deltoid muscle, avoiding the cephalic vein and thoracica-acromialis artery: the clavicular portion of the pectoral muscle is thus exposed, and is to be divided in the same direction, and to the same extent, as the external wound; the flap thus formed is then to be everted, and some loose cellular membrane being detached, the superior edge of the lesser pectoral muscle will be exposed: in this stage of the operation several branches of the thoracic arteries are in danger of being wounded. A director should then be insinuated beneath the strong fascia extending from the subclavian muscle to the coracoid process, and a portion of this fascia divided; some loose cellular membrane and a few small blood-vessels being detached with the blunt extremity of a director, the axillary vein will be exposed: this vessel should be pressed inwards towards the ribs, and the artery will be felt or seen pulsating; it must be carefully detached from the nerves for a short distance, and the aneurism needle directed under it from the thoracic to the acromial side.* In applying the liga-

* I think it must be obvious to the reader, that the several rules laid down in this work for exposing and tying the principal arteries, are applicable to cases of aneurism, or of secondary hæmorrhage after operation, rather than to cases of bleeding from gunshot or other wounds. In the latter cases, the surgeon must obviously be guided by the nature, extent, and direction of the wound, and, therefore, no accurate rule can be laid down, nor positive course of proceeding prescribed; the wound has in some measure commenced the necessary dissection, and the surgeon must follow its route to whatever extent may be necessary, to

ture, it is to be recollected, that one of the large nerves of the plexus inclines to the front of the artery, and having a pulsation communicated to it, might be mistaken for the artery itself.

Even on the dead body, this operation is by no means easily performed; but on the living subject it must be attended with considerable difficulty, particularly in corpulent persons, the depth at which, in such individuals, the artery lies, together with its complicated relations, must render the application of a ligature to it particularly hazardous. It appears to me that few cases can occur in which the operation now described ought to be preferred to that of tying the subclavian artery external to the scaleni muscles; at the same time it must be admitted, that an extensive wound passing through the pectoral muscle may expose the axillary artery, so as to render the application of a ligature to it in this situation comparatively easy: in this latter case, the surgeon will not follow the exact directions just now laid down, but will either open the wound fully, so as to expose the bleeding vessel, or will enlarge it freely by dividing the integuments and great pectoral muscle in the course of the artery, as far as may be necessary.

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expose and secure the bleeding vessel, without any regard to muscular or other coverings. I feel it incumbent on me to make these few remarks, in consequence of some observations in Mr. Guthrie's valuable work on "Diseases and Injuries of the Arteries," p. 258, and from which, I fear it might be inferred, that I had inculcated a different line of practice in cases of hæmorrhage from wounds, from that of which I fully approve.

MR. SHAW, in *Manual of Anatomy*, vol. i. p. 344, having concluded the account of Mr. Todd's case of subclavian operation, says, "the anatomy of the artery below the clavicle should be more interesting to the student, for the tying of it is a more practicable operation, and has occasionally been attended with success." Surely Mr. Shaw does not mean to infer, that in a healthy subject it is an easier operation to expose the axillary artery, by cutting through the pectoral muscle, than to tie the subclavian artery above the clavicle, where it is covered only by the general integuments of the neck; or should an operation be required in a case of axillary aneurism, that it is even practicable, in the majority of instances, to pass a ligature round the artery between the seat of the disease and the clavicle. The number of cases in which this operation has been performed are very few, and although it has in one or two instances been successful, yet from an impartial review of the cases, and still more from an attentive examination of the relative anatomy of the artery above and below the clavicle, and from having frequently practised the operation on the dead subject, in both these situations, I cannot avoid coming to a conclusion very different from that which Mr. Shaw has deduced from a comparison of the artery above and below the clavicle. The conclusion which I feel disposed to draw from such a comparison is, that in every case of axillary aneurism, in which an operation is not contra-indicated by general or local objections, that the operation of tying the subclavian above the clavicle, external to the scaleni

muscles, ought to be preferred, as being more easily performed, and being attended with less danger and injury to the surrounding parts.

The student may now proceed to trace the branches of the axillary artery; these are distributed to the muscles and glands in the axilla, to the parietes of the thorax and the muscles of the shoulder: their number is uncertain, and the order in which they arise irregular. Seven principal branches may in general be observed; four of these are called thoracic arteries, from their destination, and are distinguished by the names of, 1st, thoracica acromialis, 2d, thoracica suprema, 3d, thoracica alaris, 4th, thoracica longa: three branches pass outwardly, and supply the great mass of muscles around the scapula and shoulder-joint; these branches are named arteria subscapularis, circumflexa posterior and anterior: these external branches, although not constant in their size or situation, yet are much more uniform than the thoracic branches, which are peculiarly uncertain in number and origin.

I.

ARTERIA THORACICA ACROMIALIS,

Is an artery of considerable size; arises immediately beneath the clavicle and above the pectoralis minor, opposite the fissure between the deltoid and pectoral muscles, through which the cephalic vein passes to join the axillary vein. This artery is like a short axis; it stands out from the front of the axillary artery, and soon divides into a lash of branches which pursue three directions; first, several pass inwards and backwards towards the serratus and pectoral muscles, and anastomose with the intercostal and mammary arteries; secondly, two or three pass forwards and downwards, accompany the cephalic vein, are distributed to the deltoid muscle and integuments of the shoulder, and anastomose with branches from the circumflex and superior profunda arteries; the third set of branches run towards the acromion process, one large branch (inferior acromial artery) passes to the superior surface of this process, and joins the acromial inosculation between this artery, the transversalis colli, and supra-scapular artery; the remaining branches run beneath the deltoid, supplying this muscle and the large bursa between it and the capsular ligament; these communicate freely with branches of the circumflex arteries.

II.

ARTERIA THORACICA SUPREMA,

FREQUENTLY arises from the last described artery, sometimes above it, but in general immediately below it, and at the superior margin of the lesser pectoral muscle. The great pectoral must be divided to expose this artery, the branches of which are distributed to the two pectoral muscles, to the cellular membrane between them, also to the parietes of the thorax, and they inosculate with the mammary and intercostal arteries.

III.

ARTERIA THORACICA ALARIS,

ARISES about the middle of the axilla, and immediately divides into several branches; these supply the glands and cellular membrane in the cavity of the axilla; some pass across to the intercostal muscles, others to the pectoral and sub-scapular muscles; these arteries, with their accompanying veins, together with several nerves which pass from those in the intercostal spaces to the inner side of the arm, form an intricate plexus across the axilla. This alar thoracic artery frequently arises from some of the other thoracic branches; a fasciculus of small arteries, arising either from the axillary or some of its branches, often supplies the place of this alar or axillary thoracic artery.

IV.

ARTERIA THORACICA LONGA, VEL MAMMARIA EXTERNA,

Arises opposite the lower margin of the pectoralis minor, to which it runs parallel, and descends along the side of the thorax, between the great pectoral and serratus muscles, giving branches to these and to the integuments; it also sends branches across the axilla to the sub-scapular muscle: this artery, like the other thoracic, anastomoses with the internal mammary and intercostal arteries.

In some subjects there are five or six thoracic branches arising from the axillary artery, while in others, on the contrary, there are only two arising separately, and from these the other branches proceed. The thoracica acromialis and longa are the most regular; from the former, the thoracica suprema frequently arises, and from the latter the thoracica alaris.

V.

ARTERIA SUB-SCAPULARIS,

Is generally the largest and most regular branch of the axillary artery; it arises opposite the lower edge of the sub-scapular muscle, is at first covered by some of the nerves of the brachial plexus, runs backwards and downwards parallel to the inferior costa of the

scapula, is accompanied by a large vein, and at about one inch and a half distance from its origin it divides into an anterior and posterior branch.

1. RAMUS ANTERIOR, in direction, but not in size, appears as the continued trunk; it runs along the lower edge of the sub-scapular muscle, and internal to the serratus magnus and latissimus dorsi: near the inferior angle of the scapula it divides into numerous branches, some of which are distributed to the surrounding muscles, and descend along the side of the thorax; others pass into the substance of the sub-scapular muscle, and several continue as far as the inferior angle of the scapula, where they inosculate freely with the posterior scapular artery, which is in general a branch of the transversalis colli.

2. RAMUS POSTERIOR, or arteria circumflexa scapulæ, bends round the inferior costa of the scapula, and passes out of the axilla through a large opening, which is bounded in front by the long portion of the triceps, below by the teres major, and above by the scapula and muscles which adhere to its inferior costa; to these muscles this vessel sends several branches. The termination of this artery on the dorsum of the scapula may be exposed by placing the arm across the chest, dividing the posterior third of the deltoid muscle, and cutting through some of the fibres of the teres minor and infra-spinatus muscles; the arteria circumflexa scapulæ will then be seen dividing into an ascending and descending branch. The ascending, or the arteria infra-spinata, ascends in the infra-spinal fossa, close to the bone, a little behind the neck of the

scapula, and joins the supra-scapular artery, which descends beneath the acromion process: this artery supplies the muscles on the dorsum, and sends branches to those connected with the base of the scapula, these join the posterior scapular artery; others run towards the shoulder, enter the deltoid muscle, and anastomose with the circumflex arteries; others ascend towards the acromion, and unite with branches from the supra-scapular and thoracica-acromialis arteries. The other division of the circumflexa scapulæ runs downwards and backwards on the teres major and latissimus dorsi muscles, and at the inferior angle terminates in a free anastomosis with the posterior scapular artery, and with the anterior branch of the sub-scapular.

If the student will now observe the situation of the subscapular artery and its anterior branch, he will learn, that in operations in the axilla, it can be endangered only by dissecting towards the posterior part of this cavity. To the numerous and free inosculations that exist around the scapula, and in which the branches of the sub-scapular artery bear so conspicuous a part, the arm must be principally indebted for a due supply of blood, when the subclavian artery has been obliterated: to this anastomosis, however, I shall again refer, when taking a general review of the arteries of the superior extremities.

VI.

ARTERIA CIRCUMFLEXA POSTERIOR,

Arises from the posterior part of the axillary artery, very near the sub-scapular, and sometimes from the latter; a small part only of this artery can be seen in the axilla, for it immediately bends backwards and outwards, and leaves the axilla, by a large opening in front of the long head of the triceps, and behind the humerus, bounded below by the tendon of the latissimus dorsi, and above by the capsular ligament. The circumflex nerve accompanies this vessel, and both encircle the neck of the humerus. The branches are exposed by making a transverse incision through the deltoid muscle, the trunk of the artery will be then observed passing on the outside to the forepart of the humerus, giving numerous branches to the deltoid muscle, some of which ascend to the acromion process and shoulder-joint, others descend in the direction of the humerus, and inosculate with the superior profunda, a branch of the brachial artery.

VII.

ARTERIA CIRCUMFLEXA ANTERIOR,

Is smaller than the last described artery, from which it sometimes arises; in other instances it is given off by the subscapular, the brachial, or the superior pro-

funda; it usually arises, however, from the front of the axillary artery opposite, or a little inferior to the posterior circumflex artery. It passes outwards, and forwards behind the external cutaneous nerve, coracobrachialis, biceps and deltoid muscles; it lies close to the humerus; its branches are distributed to the muscles which cover it, also to the bone and to the capsular ligament; two or three branches ascend along the bicipital groove to the articulation, and supply the synovial membrane. This artery anastomoses directly with the posterior circumflex, superiorly with the thoracica-acromialis, and inferiorly with the superior profunda.

From the manner in which these circumflex or articular arteries encircle the neck of the humerus, they and their accompanying veins are liable to be lacerated in fractures of that part of the bone; and in such cases there is frequently considerable ecchymosis and swelling in the direction of the axilla. These circumflex arteries must be concerned also, not only in the amputation at the shoulder-joint, but also in removing the head of the bone, when fractured, or comminuted by a gun-shot, or when carious from disease or accident.

In the dissections which the student may make of these arteries, he must not expect to find every thing to correspond exactly with the foregoing detail; it would indeed be impossible to give such a description as could embrace all the varieties that are met with in this part of the arterial system; nor is the want of such attended with any disadvantage; a knowledge of

the fact that such irregularities do frequently exist in the origin of these arteries, is sufficient to lead to this practical rule, that in all operations in their vicinity great caution is to be observed.

There is, however, one variety in the axillary artery occasionally met with, which is calculated to perplex a surgeon not a little when engaged in an operation on this vessel; that is, its division into the arteries of the fore arm; this sometimes occurs so high as the lower margin of the subclavian muscle, but it is more frequently met with below this point.

When the axillary artery thus divides into two branches, the larger and deeper one receives the name of axillary or brachial, as it is to supply the arm; the smaller branch is generally found to become the radial artery, or near the bend of the elbow to join the proper brachial artery.

If a surgeon, in proceeding to tie the axillary artery, were to find two vessels, the difference in the size and situation of which could not enable him to distinguish the brachial from the irregular branch, he should endeavour to ascertain, by the cessation of pulsation in the tumour on pressure, which is the proper branch to secure. This expedient, however, will not answer in every case, for sometimes there are two or three cross branches uniting these arteries as they descend along the arm; of this I have found several examples. A knowledge that such an arrangement of these arteries does occasionally exist, may serve as an additional inducement with the operator to lay bare the artery near the seat of the disease; though such practice be not advi-

sable in aneurism in the inferior extremities, where the coats of the artery are in general found more or less diseased, yet as aneurism in the superior extremities is usually the effect of injury, there is no objection to passing a ligature around the vessel near the aneurismal tumour. If the extent of the disease did not admit of this being done, the operator must tie both arteries, and I believe, he need not have any apprehension as to the capability of the anastomosing branches establishing a collateral circulation sufficient to support the limb.

ARTERIA BRACHIALIS.

FROM the inferior margin of the tendon of the teres major muscle to the bend of the elbow, the continuation of the axillary artery receives the name of brachial. To expose this artery, the student should first raise the integuments from the arm and upper part of the fore arm, preserving the cutaneous veins in their natural situation, particularly at the bend of the elbow, where venesection is usually performed.

The cutaneous veins of the arm arise from a plexus of these vessels on the back and front of the hand and fingers by three principal branches, viz., the vena cephalica, basilica, and mediana. The vena cephalica ascends along the radial side of the fore arm to the bend of the elbow, where it receives the branch of the median vein, called median cephalic; it then continues to ascend along the outer side of the arm, at first lying between the biceps and supinator radii longus, then between the biceps and triceps, and lastly, between the pectoral and deltoid muscles; a little below the clavicle it sinks deep to join the axillary vein. The cephalic vein is accompanied from the elbow to he hand by branches of the external cutaneous nerve.

The basilic vein ascends on the ulnar side of the fore arm, and near the bend of the elbow receives the median basilic branch from the median vein; the basilic vein then ascends along the inner side of the bi-

on the brachialis anticus muscle. At the upper and inner side of the arm, the brachial artery lies between the coraco-brachialis and triceps muscles, but in the middle and lower thirds, it is between the biceps and triceps muscles, which are connected to each other by the fascia of the arm; in the middle third of the arm, it should be particularly observed, that the belly of the biceps overhangs the artery. The brachial artery is accompanied by two veins, one on either side; the basilic vein also sometimes runs superficial to it as far as the axilla, where it joins the axillary vein: the venæ comites are frequently connected by small branches, which run spirally, and form plexures around the artery. The internal cutaneous nerve runs parallel and superficial to the artery, the ulnar nerve is on its ulnar and posterior side, and separated from it, in the inferior third of the arm, by the intermuscular ligament; in the upper third of the arm, the median, or brachial and the external cutaneous nerves are on the external or radial side of the artery, but in the middle third of the arm, the brachial nerve crosses the artery superficially, and inferiorly it lies to its ulnar side, separated from it by some cellular membrane, and by one of the venæ comites; this relative position of the median nerve to the artery is subject to variety; near the axilla it often lies on the ulnar side of the artery, and in the middle of the arm it sometimes passes between the artery and the bone; but, inferiorly, the nerve very generally lies to the ulnar side. This circumstance should be recollected in the operation of tying the brachial artery.

When the artery arrives near the bend of the elbow, it recedes a little from the surface, and passes into a space which is bounded externally by the supinator-longus muscle, internally by the pronator teres; the brachialis anticus muscle and the elbow-joint bound it superiorly and posteriorly, and the triangular or semilunar fascia of the biceps covers it in front; into this space the brachial artery and veins, the median nerve, and tendon of the biceps, all descend, the artery lying between the nerve and tendon, the latter being to its radial, and the former to its ulnar side. In this space, and in general opposite to the coronoid process of the ulna, the brachial divides into the radial and ulnar arteries; in size, the ulnar is the principal branch, but in direction, the radial appears the continuation of the brachial.

The branches of the brachial artery are very numerous; few, however, observe any regular course, or have received distinct names; through its entire extent it sends branches externally and internally; from its internal side arise its three principal branches, and which have been considered sufficiently regular and large to have received distinct names: these are, arteria profunda superior, profunda inferior, and anastomotica magna. In addition to these, however, several small branches pass to the triceps and integuments. When there is a division of the brachial high in the arm, in general one only of the branches gives off the several arteries just enumerated.

I.

ARTERIA PROFUNDA SUPERIOR,

Is generally the first branch of the brachial; it arises a little below the tendon of the teres major muscle, from the posterior part of the artery; it immediately sends off several branches to the triceps and coracobrachialis muscles, and some, which ascend along the humerus and deltoid muscle to anastomose with the circumflex and acromial thoracic arteries. The superior profunda artery then descends, inclining a little backwards and outwards between the bone and long portion of the triceps, having the second and third divisions of this muscle on either side; it sends off several twigs to the triceps, and about the middle of the arm divides into two branches. One of these descends towards the olecranon, between the humerus and triceps, supplying the latter, and sending branches to the elbow-joint, which anastomose with the ulnar and interosseous recurrent arteries; the other branch of the superior profunda may be named the musculospiral artery, as it accompanies the nerve of that name round the back part of the humerus, it pierces the second portion of the triceps, and descending towards the external condyle, divides into several branches; some of these pass behind, others along, and some anterior to the ridge leading to the external condyle; the anterior branches descend between the supinator longus and brachialis-anticus muscles, lie

close to the bone, and are covered by the musculo-spiral and external cutaneous nerves and the cephalic vein; these branches anastomose very freely with the radial recurrent artery, while the external and posterior branches inosculate with the interosseous recurrent.

The superior profunda artery sometimes arises from the sub-scapular or from the posterior circumflex, and in some instances it is so large as to appear like a division of the brachial artery itself, in which case it sends off the next branch, or the inferior profunda; the musculo-spiral branch also is frequently very large, and may require a ligature in amputation of the arm, particularly if there have been any long continued disease of the elbow-joint; this artery lies very close to the bone, and escaping observation at the time of the operation, may bleed smartly some hours afterwards; the surgeon should, therefore, examine for it, and with tenaculum or forceps draw it out of a tendinous canal into which it frequently recedes.

II.

ARTERIA PROFUNDA INFERIOR.

This artery usually arises in the middle third of the arm, opposite the insertion of the coraco-brachialis muscle; it pierces the internal intermuscular ligament, and ascends obliquely inwards and backwards to the fossa between the internal condyle and olecranon pro-

cess, where it ends in a free inosculation with the posterior ulnar recurrent. The inferior profunda at first lies on the coraco-brachialis tendon, then on the brachialis posticus, or third division of the triceps, and is accompanied by the ulnar nerve, which lies on its internal or ulnar side. This artery gives branches to the integuments and to the brachialis-anticus muscle, some of which inosculate with the anastomotica magna. In the dissected arm, the inferior profunda artery appears at some distance from the brachial, but if the triceps be pressed forward towards the biceps, so as to place these muscles as nearly as possible in their natural relations, those vessels will be found very close to each other; so that, in cutting down upon the brachial artery, in the middle of the arm, in the living subject, the inferior profunda, from its situation, and from its being accompanied by the ulnar nerve, may be mistaken for the brachial; this error, however, may be avoided by recollecting that the brachial artery is the nearest to the biceps, and is a little covered by that muscle; in general, also, there is a material difference in size between the two vessels.

III.

ARTERIA ANASTOMOTICA MAGNA,

Arises from the brachial in the lower third of the arm, runs inwards and a little downwards towards the internal condyle, bends very tortuously across

the brachialis-anticus muscles, pierces the internal intermuscular ligament, and between the olecranon process and internal condyle, anastomoses with the inferior profunda, and with the posterior ulnar recurrent arteries. As the anastomotica magna is crossing the brachialis muscle, branches ascend from it to meet the inferior profunda, and others descend in front of the inner condyle, and join the anterior ulnar recurrent; one or two small lymphatic glands may, in general, be seen attached to this artery or its branches. This artery sometimes arises from the ulnar. It is not unfrequently absent, small branches from the brachial and ulnar recurrents supplying its place. In cases of high division of the brachial artery, the branches just enumerated generally arise from that which is to become the ulnar, sometimes the anastomotica comes from the radial branch.

From the radial side, as well as from the posterior part of the brachial artery, arise several branches; these may be considered under the general name of muscular arteries; there are generally three or four of considerable size, one goes to the coraco-brachialis, two or three to the biceps, and one to the brachialis-anticus muscles; all these anastomose with each other and with the muscular branches of the profundæ arteries. About the middle of the arm the brachial artery gives off from its outer side a branch called *Arteria Nutritia Humeri;* this artery generally pierces the tendon of the coraco-brachialis muscle, and sends several branches to the surrounding parts; it enters the bone obliquely downwards, and

soon divides into many branches, which run in different directions to supply the cancelli and medullary membrane of the humerus, and to anastomose with the other nutritious vessels which enter the bone at its extremities.

If the humerus be fractured near its centre, this artery may be injured, and may pour out blood in such quantity as may prevent or retard the process of bony union. I have heard of one case; in which an aneurism of this artery ensued on a fracture of the bone, and amputation was deemed necessary. This artery sometimes arises from the superior profunda.

If the arteries of the arm be minutely injected and carefully dissected, the student will observe numerous anastomoses to exist from the shoulder to the elbow; some occur in the integuments, several in the muscles and even round the bone many arteries may be seen inosculating with each other. Around the elbow also a free communication takes place between the different branches of the brachial artery and the several recurrents from the fore arm, through which the radial and ulnar arteries will receive an ample supply of blood, when the brachial artery shall have been obliterated near its inferior extremity; even if this trunk be obliterated near the axilla, collateral circulation will be established through the inosculations of the scapular, acromial-thoracic, and circumflex arteries, with branches of the superior profunda; and the anastomoses of the profundæ arteries, and anastomotica magna, with the recurrent branches of the radial and ulnar arteries, will complete the chain of commu-

nication between the vessels of the shoulder and those of the fore arm.

Before the student proceeds to dissect the arteries of the fore arm, he should consider what practical deductions may be drawn from the dissection he has made of the brachial artery; he may first observe the practicability of compressing this artery in almost any part of its course, and may learn the direction in which the pressure should be applied in the different parts of the limb; if the artery is to be compressed in the upper part of the arm, the compress should be placed on the ulnar side of the humerus; and at any point inferior to this, the biceps must be the guide, and the compress should be small, so as to admit of being pressed a little under the inner edge of this muscle. The brachial artery is most favourably situated for compression as it is passing over the insertion of the coraco-brachialis muscle; pressure, however, applied in this situation, is attended with acute pain, in consequence of the median nerve being unavoidably pressed with the artery against the bone.

The operation of tying the brachial artery may be required in cases of wound, of aneurism of the brachial artery, or of the radial, ulnar, or even of the interosseous* arteries in the upper part of the fore arm. The brachial artery may be exposed in the upper part of its course in the following manner: the patient may be laid horizontally, or seated on a low chair, and the

* See Dublin Hospital Reports, vol. iii. p. 135.

affected arm raised from the side, and placed on a table, the hand supinated; feel for the pulsation of the artery, and observe the line of the coraco-brachialis muscle, and along the ulnar side of this muscle make an incision through the integuments about two inches and a half long, and divide the subjacent cellular membrane cautiously, so as to avoid injuring the internal cutaneous nerve or the basilic vein, which sometimes runs superficially as high as the axilla; the fascia of the arm is next to be divided in the same direction as the external incision. The operator should recollect, that in this situation the ulnar and internal cutaneous nerves are on the ulnar side of the vessel, and that the external cutaneous and median nerves are on its radial side, but that the median nerve in some subjects is superficial to the artery in this part of the arm: if the fore arm be flexed, these several nerves become relaxed, and can be drawn to either side, then by removing some cellular membrane, the brachial artery and veins may be observed. It will sometimes happen that the artery, when exposed, does not pulsate, and there may be some difficulty in distinguishing it from the nerve or veins; alternately compressing the vessels at the inferior and superior extremity of the wound, may assist in the discrimination, and putting the arm in a relaxed position may restore pulsation in the artery: the operator should carefully separate the veins from the artery, and then pass the aneurism needle around the latter, directing it from the ulnar to the radial side, and avoiding the veins and nerves on either side.

Should two arteries be exposed, in consequence of a high division, the operator should endeavour to ascertain, by pressure, which vessel communicates with the wound or aneurismal sac, and apply the ligature accordingly; but if the pulsation cease only when both vessels are compressed, he will be justified in tying both, as he may then conclude that these arteries communicate with each other above the seat of disease or injury.

The brachial artery may be tied in the middle division of its course, by making an incision along the ulnar side of the biceps muscle, of the same extent and with the same caution as was recommended in the former operation; the fascia of the arm being divided, the operator should bend the fore arm, so as to relax the biceps, and then, by raising the inner margin of this muscle, the brachial nerve will be exposed, lying superficial to the brachial vessels; (in some subjects, however, the nerve lies between the artery and bone:) this nerve is to be drawn inwards with a blunt hook, and the biceps pressed outwards by a broad curved retractor, the brachial artery and veins are then exposed, and the operation is to be concluded as before.

In performing the operation in this situation, there is danger of mistaking the inferior profunda artery and ulnar nerve for the brachial artery and nerve, particularly if the collateral vessels have become enlarged in consequence of disease obstructing the flow of blood through the main trunk; hence, the necessity of directing the incision towards the biceps, or towards the

axis of the humerus, rather than inwards or backwards towards the triceps.

For the cure of aneurism, which occurs at the bend of the elbow, in consequence of the artery being wounded in performing venesection, the brachial artery should be tied in the inferior part of its course, and as near as possible to the aneurismal sac; in such a case the surrounding parts are often greatly changed, not only in their appearance, but in their relative situation; indeed in some cases the tumour itself will be the only guide to the artery which supplies it. In performing the operation in this situation, the surgeon should recollect, that the brachial nerve is on the ulnar side of the artery.

The student may now direct his attention to the relative position of the cutaneous veins to the artery at the bend of the elbow: he should first replace the fascia of the biceps, and observe how this binds down the artery into the triangular space which it covers, and from this he may infer how capable it is of restraining the growth and modifying the form of an aneurism in cases in which the brachial artery has been wounded through this aponeurosis; if he replace the cutaneous veins, he will observe, that the median basilic runs nearly parallel to the brachial artery, but superficial to the aponeurosis of the biceps, in consequence of which this vein is observed, in the living arm, to stand out more prominent than the other cutaneous veins, and is, therefore, more frequently selected for blood-letting. The student should particularly observe, that this fascia does not, in general,

separate the vein and artery for any considerable distance, and he ought, therefore, to recollect, that, in performing venesection, if he perforate the median basilic vein exactly opposite the angle of flexion of the elbow, or a little above it, in these situations the artery is not separated from the vein, nor is it protected by this aponeurosis. Sometimes the brachial or radial artery is wounded by very bold and ignorant pretenders, without the vein being opened at all.

If the basilic vein be opened below the bending of the elbow, and that the lancet pierce the vein and fascia of the biceps, and then wound the brachial or radial artery, the patient will, most probably, have an ordinary circumscribed aneurism, in consequence of the pressure which is immediately applied to stop the hæmorrhage exciting adhesive inflammation around the blood that has been effused beneath the fascia of the biceps and of the fore arm; in such a case, the surgeon must tie the artery in the inferior division of its course, and as close to the disease as he possibly can.

I do not recollect a case of this sort of circumscribed aneurism, from the infliction of a simple wound, in which it has been necessary to open the sac, or tie the artery below it, I am therefore disposed to place full reliance on the practice of simply laying bare the vessel as close to the tumour, as circumstances will permit, and tie it with a single ligature. Dr. Colles, whose experience and great opportunity for observation render every practical remark of his worthy of attention, thus expresses himself on this subject,

in his Course of Lectures on the Theory and Practice of Surgery: "I have operated repeatedly, and with success, for the cure of circumscribed brachial aneurism, in consequence of injury to the artery in performing venesection; I have also frequently assisted others in operating for the same cause, and with the same result, and I never yet found it necessary to open the aneurismal sac, or to look for the vessel below the tumour, or to apply more than one ligature around the artery, and which I think ought always to be tied as near as possible to the seat of the disease; for in this species of aneurism, the coats of the vessel have not undergone any morbid change, as is generally the case in anenrism in the inferior extremity."

I have known several cases of this species of aneurism, and from the same cause in young persons, in whom a perfect recovery was accomplished by the application of gentle pressure on the part, by bandaging the fingers, hand, and fore-arm, by rest and suitable constitutional treatment; I should, therefore, recommend in almost every recent case of this disease, a trial of this practice before having recourse to an operation;* at the same time, however, it is right to observe, that pressure ought not to be indiscriminately

* Were a surgeon present at, or immediately after the occurrence of such an accident, should he at once extend the wound so as to expose the artery, and tie it both above and below the opening, or should he close the external wound, and attempt the cure by compression? I do not consider this question to be decidedly settled even at the present day; my own experience would incline me to give a fair trial to the latter practice.

applied, nor too long persisted in, as in some cases it may induce absorption, or ulceration in the integuments, and expedite the progress of the tumour to the surface, and in others it may convert a circumscribed into a diffused aneurism, and thus aggravate the disease.* Brachial aneurism, however, which commences at the bend of the elbow, in consequence of a wound, is not always circumscribed; sometimes the tumour extends up the arm between the biceps and triceps muscles, the fascia of the arm and the intermuscular ligament preventing its increase in a lateral direction; in one instance I saw the disease extend from the elbow near to the axilla. In such cases of diffused aneurism, the plan of treatment by compression, or the simple operation of tying the brachial artery in the upper part of its course, that is immediately above the tumour, may sometimes (though I fear will very rarely) succeed; there can be no objection however to a cautious trial of pressure aided by judicious constitutional treatment:† this attempt, how-

* See cases of aneurism reported by W. Campbell, *Dublin Journal of Med. and Chem. Science*, No. II. May, 1831.

† Mr. Todd informed me, that a case of this accident was admitted under his care in the Richmond Surgical Hospital, and was successfully treated *without operation*. The patient, a police officer, was of a full habit; the tumour was large, with strong pulsation, and the general swelling of the arm very considerable. Active depletion, moderate compression of the limb, an horizontal position, and latterly, friction and compression more directly applied to the tumour, were the curative means resorted to. The tumour has been entirely absorbed, and the patient sustains no inconvenience whatsoever.

ever, ought not to be persevered in too long unless symptoms of improvement be soon manifested. Many years since I saw a case of this diffused aneurism, in which the simple operation of tying the brachial artery in the upper part of its course, was performed with success by Mr. Wilmot in Jervis-street Infirmary, and a perseverance in the use of moderate compression for some weeks after the main artery was thus tied, caused the total disappearance of the disease.

A few such cases at one time made such an impression on my mind, that I was of opinion, that the simple operation of applying a single ligature at the upper part of the tumour, would suffice for the cure of the diffused, as I do believe it will in almost all cases of the circumscribed aneurism. In the former editions of this work, I have accordingly expressed my sentiments on the practice to be pursued in this disease, in a somewhat different manner from what I now do. I now believe that very few cases of diffused aneurism, either of this, or of any other artery, will admit of cure from the simple operation and application of a single ligature to the artery above the injured part, but that it will be almost always necessary to lay open the tumour, by a long incision which should include, if possible, the original wound; the coagula should be removed, as far as can be without violence, then search must be made for the wounded vessel, which in some cases is not discovered without much time and trouble. Relaxing the tourniquet or the pressure which has been applied above, will sometimes lead the operator to it; the wound will often appear very distinct, particularly

if some days or weeks have intervened, the orifice being white and well defined, and capable of admitting a probe. In a very recent case of wound of the brachial artery, with effusion of blood into the surrounding parts, I have experienced much more difficulty in exposing the vessel, than in those cases where the operation has been required, after the lapse of several weeks from the infliction of the injury. When the injured vessel shall have been exposed, it may be raised by a probe, either introduced into it through the wound, or the aneurism needle can be passed around it, and the artery tied first above, and then below the opening. I have stated, that in almost every case of diffused aneurism, this practice must be adopted, of cutting into the diseased mass, and searching for the artery; cases however may arise, and such have actually occurred, when the wound of the artery has been complicated with so much injury of the surrounding parts, particularly of the adjacent articulation, that such an operation would expose the patient to all the additional risk of that fever and inflammation, which usually attend open wounds of joints. In such cases it would appear preferable to secure the main artery of the limb at some little distance from the injury; this operation, assisted by gentle local compression, and suitable general treatment, may lead to a favourable issue. It is, however, almost unnecessary here to add, that in many cases of this nature amputation must be had recourse to.

In performing venesection, if the lancet wound the artery above the semilunar edge of the fascia of the

biceps, pressure may cause a direct adhesion between the edges of the opening in the back of the vein and in the front of the artery, so that at each systole of the heart, part of the blood is propelled from the artery into the vein, causing this vessel to become varicose and distended immediately in front of the artery; this affection is denominated an aneurismal varix. From the same causes adhesive inflammation may connect the vein and artery, but at some distance, in consequence, perhaps, of blood being effused between them: a small intervening sac will then be formed communicating with both vessels, and producing the same effects on the vein as in the aneurismal varix: this disease is named varicose aneurism. In these last-mentioned forms of aneurism, the operation of tying the brachial artery will be very seldom required, except in some rare instances of varicose aneurism, in which the intermediate sac has increased in size, and compressing the vein has extended itself as a common aneurismal tumour so as to require similar treatment. Should an operation be required in either of these species of aneurism, I consider it would be useless to attempt any other than that recommended for the diffused aneurism, namely, tying the artery both above and below the injury.

Thus, from accident in venesection, four forms of aneurism may arise; first, circumscribed aneurism, filling up the hollow at the bend of the elbow, which is to be treated either by compression, or by the single ligature; secondly, diffused aneurism, in which the disease extends from the elbow along the line of the

artery towards the axilla; in this form of the disease, if pressure do not answer, the artery must be tied both above and below the wound; thirdly, aneurismal varix; and fourthly, varicose aneurism: in neither of which will an operation be generally required, except under the circumstances above mentioned.

When the radial artery arises high in the arm it descends parallel to the proper brachial, and lies more superficial, particularly at the bend of the elbow, and is, therefore, in greater danger of being wounded in opening the median basilic vein: however, I have never seen, in any irregular distribution of the arteries of the arm, any branch of importance run superficial to the fascia of the biceps or of the fore arm, although I have remarked, that the radial artery, in cases of this high division of the brachial, is not so much overlapped by the pronator and supinator muscles, as when it arises from the brachial in the hollow at the bend of the elbow.*

* Every person who has been in the habit of dissecting arteries, must have observed great variety in the brachial artery, both in respect to the place in which it divides, as well as in the size of the superficial or irregular branch, which, however, in most instances becomes the radial artery. It is impossible to state in what proportion these varieties occur; they are met with more frequently in one season than in another. In the session of 1821-2, I examined the brachial arteries in forty injected subjects, and in four only was there a high division, and in each of these, it was the radial artery that arose thus high in the arm. In the session of 1822-23 I again took notes of the appearance of the brachial arteries in forty injected subjects, and

The student may now proceed with the dissection of the radial and ulnar arteries; he should first raise the integuments from the fore and back part of the arm and hand, leaving the general fascia uninjured, to the connexions of which he should attend.

The fascia of the fore arm is continued from that of the arm; it adheres to the condyles of the humerus and to the muscles which arise from them; it receives additional fibres from the aponeurosis of the biceps; it confines all the superficial muscles and tendons of the fore arm, and sends processes beneath these to bind down the deeper seated muscles; it is very tense on the back of the fore arm, and adheres to the olecranon process and to the posterior part of the ulna; inferior-

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in seventeen of them irregularities in these arteries existed. In ten there was a high division of the brachial into the radial and ulnar arteries; in three, a small branch arose from the upper part of the brachial, and descending to the elbow, it joined the radial artery; in two instances this superficial branch descended in the fore arm, beneath the superficial flexors, and was distributed to the muscles in this region; and in two cases, this superficial branch accompanied the brachial nerve beneath the annular ligament of the carpus, and joined the superficial palmar arch of arteries.

In these eighty subjects, the brachial arteries of which I particularly examined, the ulnar and interosseous arteries were perfectly regular. I have, however, seen instances in which the ulnar artery was the most superficial at the bend of the elbow, and passed between the fascia, and the flexor and pronator muscles. Subsequent experience has tended to confirm the opinion, that the proportion of the irregular to the regular arrangements, will be about as one to four. I have lately seen an inte-

ly it is also connected to the radius and to the annular ligaments of the carpus. On the back of the hand the integuments are thin and the fascia weak; but in the palm of the hand the fascia is very strong, the integuments are very thick, and the adipose substance is of a peculiar granulated appearance, and supplied with a great number of small arteries. The palmar aponeurosis is united to the anterior annular ligament, and receives fibres from the tendon of the palmaris longus, and from the fascia of the fore arm; it adheres to the muscles of the thumb and of the little finger, is extended over the tendons, nerves, and vessels, binds these down in the hollow of the palm, and is very tense when the fingers are extended; opposite

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resting variety in these arteries, the brachial divided very high into three branches, two of which united to form the radial, which gave off the anterior interosseous, while the posterior interosseous was derived from the ulnar. I may remark, that in the great proportion of varieties in the arteries of the fore arm, there is an excess above the natural number, whereas, in those of the leg a diminution is more common, thus, the fibular artery is often wanting, or the anterior tibial very small. The arterial ramifications are more numerous in the fore arm, than in the leg, probably on account of the greater number of muscles in the former, as well of their greater sensibility, as evinced in their delicate, varied, and rapid motions. As many of the varieties in the larger branches of the arterial system in man, are only repetitions of the natural arrangement in other animals, can we venture to assimilate the tendency to frequent divisions of the brachial artery, to that naturally divided state of the arteries in the extremities of some of the tardigrade animals?

the digital end of the four metacarpal bones, the fibres of this aponeurosis separate, and are inserted into the sheath of each of the flexor tendons, and into the sides of the first phalanges. The palmar aponeurosis is composed of radiating fibres, which run from the annular ligament of the carpus towards the fingers, and before they separate to go to their insertion, they are crossed by very strong transverse bands.

The fascia of the fore arm may be now divided, and by separating the supinator radii longus muscle from the pronator teres, the origin of the two principal arteries of the fore arm will be exposed. The radial artery is most superficial in the fore arm, but its terminating branches lie very deep in the hand; the ulnar artery, on the contrary, lies deep on the upper part of the fore arm, and its termination in the hand is superficial; the ulnar is larger than the radial, and gives off the interosseous; the radial, however, in direction, appears to be the continuation of the brachial: the student will find it most convenient to examine this artery first.

ARTERIA RADIALIS.

The radial artery, whether it arise from the brachial at the bend of the elbow, or at any distance above this, always runs along the radial side of the fore arm to the wrist, (if a line be drawn from the middle of the bend of the elbow to the thumb it will be parallel to the radial artery,) it then turns round the outer side of the carpus, beneath the extensor tendons of the thumb, and running forwards, sinks into the cleft between the metacarpal bones of the thumb and index finger, where it terminates by dividing into three branches.

The student should first examine the relative anatomy of this artery in the fore arm. In this region the radial artery is covered only by the integuments and general aponeurosis, and by the fascia which covers the deep-seated muscles. In the upper third of the fore arm the radial artery is concealed by the pronator teres muscle on its ulnar, and by the supinator longus on its radial side; by gently separating these, the artery is exposed: in the middle third it lies between the tendons of the flexor carpi radialis on its ulnar, and supinator longus on its radial side, the tendon of the supinator extending over it a little; in the inferior third of the fore arm the tendon of the flexor carpi radialis is still to its ulnar side, and the tendon of the supinator longus and the external edge of the radius are to its radial side.

In the superior third of its course, the radial artery lies on the tendon of the biceps, on a quantity of cellular membrane and fat, and on several branches of the musculo-spiral nerve, all which connect it to the supinator radii brevis muscle. In the middle third of the fore arm, the radial artery lies on the tendon of the pronator teres, and on the radial origin of the flexor digitorum sublimis. In the inferior third of the fore arm the radial artery lies on the flexor pollicis, on the pronator quadratus, and on the extremity of the radius: it is accompanied through its whole course by two veins, which usually lie anterior to it, these occasionally unite into one. The radial or musculo-spiral nerve runs parallel to it, and lies to its radial or external side, it is only in near connexion with it during the middle third of the fore arm.

As the radial artery passes round the outer side of the carpus, towards the cleft between the thumb and index finger, it lies upon the capsular and external lateral ligaments of the carpus, and on the head of the first metacarpal bone; in this part of its course it is covered by the integuments and by three extensor tendons of the thumb.

In some subjects the radial artery turns round the radius at the distance of an inch, or even more, above its inferior extremity, and then descends along the back of the carpus to the angle between the thumb and index finger; a large cutaneous vein and a branch of the musculo-spiral nerve run superficial and parallel to this portion of the artery. The radial artery then sinks into the cleft between the metacarpal

bones of the thumb and index finger, behind the adductor indicis and abductor pollicis muscles; in some cases it perforates these muscles; and in this space it divides into its three terminating branches.

The radial artery sends off a number of branches, few of which, however, are of sufficient size or importance to have received distinct names: almost immediately after its origin it sends off its first, and one of its principal branches.

1. ARTERIA RADIALIS RECURRENS is a large tortuous artery; it is concealed by the supinator longus, and lies upon the supinator brevis; its branches are entangled in a quantity of loose cellular membrane and in the divisions of the musculo-spiral nerve. The radial recurrent first runs outwards, then bends upwards, in an arched manner, and ascends in front of the external condyle of the humerus, and between the supinator longus and brachialis anticus muscles. From the radial recurrent several branches descend to supply the supinator longus and brevis muscles, others are distributed to the synovial membrane, and to the brachialis anticus muscle, and the continuation of the artery ascends close to the humerus, and inosculates with the musculo-spiral artery, a branch of the superior profunda. When the radial arises from a high division of the brachial in the arm, this recurrent branch will often be found to proceed from the ulnar, or the continued brachial.

As the radial artery descends along the fore arm, it gives off numerous small twigs to the muscles on

each side, and about an inch above the lower end of the radius it sends off the next branch of importance.

2. Arteria superficialis volæ. This artery runs superficially downwards and inwards over the annular ligament of the carpus, over and partly through the origin of the small muscles of the thumb; it distributes branches to these muscles and to the integuments of the palm of the hand, and anastomoses with the superficial palmar artery from the ulnar, thus completing the superficial palmar arch of arteries. There is a great variety in the size and origin of the superficialis volæ artery; sometimes it is as large as the continuation of the radial, and arises from it high in the fore arm, and runs down parallel to it as far as the wrist: in such a case it not only anastomoses very freely with the superficial palmar artery, but also sends a digital branch to the thumb or index finger; at other times the superficialis volæ is extremely small, and sometimes is altogether wanting.*

3. Arteria anterior carpi radialis is a small branch; its name implies its situation; it runs across the lower extremity of the radius beneath all the flexor tendons, supplies the ligaments and bones of

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* To the finger, feeling the pulse of an individual in whom the superficialis volæ arose higher and was larger than usual, a sensation of a fuller and stronger pulsation might be communicated, than was natural or consistent with the symptoms of disease under which the patient laboured. It may not be amiss then, in particular cases, to feel the pulsation of other arteries beside that of the radial.

of the fore arm by making an incision two or three inches in length over the ulnar edge of the supinator longus muscle, then by dividing the two layers of fascia, as in the last described operation, the artery will be exposed, and the aneurism needle may be passed under it from its radial to its ulnar side, avoiding the veins and the musculo-spiral nerve, which in this situation lies to the radial side, and very near the artery.

The radial artery may be tied in the inferior third of the fore arm, by making an incision two or three inches long at the radial side of the tendon of the flexor carpi radialis; the fasciæ are to be then divided, as in the former operations, and the artery is easily exposed.

In case of wound of this artery, from a gunshot or a puncture, it will be advisable to apply two ligatures, one above, and the other below the opening. In case of circumscribed aneurism, one ligature, applied close to the tumour, will suffice. The directions as to the extent and exact course of the incisions apply to cases of aneurism. In recent wounds of this, as of other arteries, the practice and "modus operandi" must be much influenced by the position and extent of the injury.

ARTERIA ULNARIS.

THE ulnar artery runs obliquely from the division of the brachial, towards the ulnar side of the fore arm, between the two layers of flexor muscles, whose direction it somewhat crosses; near the wrist it bends a little outwards, or towards the mesial line, passes over the annular ligament on the radial side of the pisiform bone, to which it is attached by a strong band of fibres, which connect this bone to the annular ligament; the ulnar artery then runs along the palm of the hand, between the palmar aponeurosis and the flexor tendons, towards the metacarpal bone of the index finger, where it inosculates with the arteria superficialis volæ and radialis indicis.

In this course the ulnar artery is covered, in the superior third of the fore arm, by the superficial flexors and pronators, namely, the pronator teres, flexor carpi radialis, palmaris longus, and flexor digitorum sublimis; the ulnar nerve also lies superficial to it, and crosses it at the upper part of the fore arm. In the middle and inferior thirds of the fore arm it is only covered by the integuments and general aponeurosis, and by a deep layer of fascia, which passes from the tendon of the flexor ulnaris to the flexor digitorum profundus. In the inferior third of the fore arm the pulsation of the artery can be felt, but not in the middle third, for there the flexor ulnaris and

merous branches, which are distributed to the cellular membrane and integuments in the same manner as in all the other fingers.

8. ARTERIA PALMARIS PROFUNDA,* sinks deep into the palm of the hand, between the metacarpal bones of the thumb and index finger, and runs across the interossei muscles and the four metacarpal bones near their carpal extremity; this artery is covered by the flexor tendons and lumbricales muscles, and opposite the metacarpal bone, supporting the little finger, it inosculates with the arteria communicans, a branch from the ulnar artery, thus completing the deep palmar arch. The slight convexity of this arch is directed towards the fingers, and gives origin to four or five small branches which supply the interossei muscles; some of these branches run as far as the cleft between the fingers, and anastomose with the digital arteries from the superficial palmar arch.

The student may now consider in what situation the radial artery may be exposed during life, for the purpose of passing a ligature around it.

A surgeon may be required to tie the radial artery in any part of its course in consequence of aneurism, or of wounds either of the trunk of the artery or of some of those branches which are distributed to the thumb and palm of the hand, particularly of the superficialis volæ, or of that large branch which often

* The student may postpone the dissection of this branch until he has traced the ulnar artery to its termination, and exposed all the superficial arteries in the palm of the hand.

the pronator teres muscle, on the anterior surface of the joint, and on the brachialis anticus muscle, to all of which it gives several branches; it anastomoses with the arteria anastomotica magna, and with branches from the inferior profunda. The posterior recurrent is an artery of very considerable size; it passes upwards and backwards beneath the ulnar nerve, behind the internal condyle, and between the two origins of the flexor carpi ulnaris; it gives several branches to this muscle, also to the lower part of the triceps, and to the synovial membrane of the elbow-joint, and in the fossa between the internal condyle and olecranon process, this artery terminates in a free inosculation with the inferior and superior profundæ and anastomotica magna.

Immediately after its recurrent branches the ulnar artery sends backwards its *third* branch, viz., the *Interosseous Artery*, the dissection of which the student may defer until that of the ulnar artery is concluded. As the ulnar artery descends along the fore-arm, it sends off numerous branches to the muscles, one in particular, which arises immediately after the interosseous artery, and runs down the middle of the fore-arm along with the brachial nerve, and is distributed to the superficial flexors: in some subjects this branch is very large, and passes beneath the annular ligament of the wrist, along with the flexor tendons; in the palm of the hand it becomes superficial, and joins the centre of the superficial palmar arch of arteries; in such a case, if this arch or any of its branches be wounded, there must be considerable

of the fore arm by making an incision two or three inches in length over the ulnar edge of the supinator longus muscle, then by dividing the two layers of fascia, as in the last described operation, the artery will be exposed, and the aneurism needle may be passed under it from its radial to its ulnar side, avoiding the veins and the musculo-spiral nerve, which in this situation lies to the radial side, and very near the artery.

The radial artery may be tied in the inferior third of the fore arm, by making an incision two or three inches long at the radial side of the tendon of the flexor carpi radialis; the fasciæ are to be then divided, as in the former operations, and the artery is easily exposed.

In case of wound of this artery, from a gunshot or a puncture, it will be advisable to apply two ligatures, one above, and the other below the opening. In case of circumscribed aneurism, one ligature, applied close to the tumour, will suffice. The directions as to the extent and exact course of the incisions apply to cases of aneurism. In recent wounds of this, as of other arteries, the practice and "modus operandi" must be much influenced by the position and extent of the injury.

of the metacarpal bone of the index finger, nearly parallel to that fold or wrinkle which is observed in the integuments of the palm when the hand is half closed; this artery then ascends, and between the ball of the thumb and index finger it anastomoses with the superficialis volæ, and with a branch from the arteria radialis indicis, thus forming a sort of semicircle, which is the superficial palmar arch of arteries. The convexity of this arch is directed towards the little and ring fingers, the concavity towards the small muscles of the thumb.

The superficial arch of arteries is nearer to the fingers than the deep arch, and lies more obliquely in the palm of the hand; the deep arch is placed almost transversely upon the metacarpal bones near their carpal extremities. Parallel to the deep arch of arteries, is a large branch of the ulnar nerve, whereas the superficial arch has parallel to it a large branch of the brachial or median nerve, which unites with a small branch of the ulnar nerve, and forms an arch of nerves which lies behind that of the arteries; from this arch of nerves digital branches pass off to the fingers, accompanying the digital arteries; opposite each cleft between the fingers, the digital artery perforates its accompanying nerve, and as they run along the side of the finger, the nerve lies most superficial, and is constantly sending off branches which twine around the artery, and form a plexus upon its coats; on the last phalanx the nerve and artery enlarge, and the latter again perforates the former; they then terminate in minute branches, which are distributed to the in-

sublimis almost cover it; in the palm of the hand the ulnar artery is covered by the integuments, by the palmaris brevis, and by the palmar aponeurosis.

The ulnar artery, immediately after its origin, lies for a short distance on the brachialis anticus muscle; in the three divisions of the fore arm it rests on the flexor digitorum profundus; at the wrist it lies on the annular ligament; and in the hand it crosses over the several tendons in that region. When the origin of the ulnar artery is from a high division of the brachial, it almost always lies immediately beneath the fascia of the fore arm.

The ulnar artery is accompanied by two veins, one at either side; the median or brachial nerve is connected to the ulnar artery for about an inch, but this nerve then perforates the pronator teres, and is separated by the ulnar origin of this muscle from the artery, and then descends in the middle line of the fore arm. At the lower part of the upper third of the fore arm the ulnar nerve becomes attached to the artery, and accompanies it as far as the hand; in the fore arm the nerve lies to the ulnar side of the artery, but on the annular ligament it is rather posterior to it.

In this course the ulnar artery sends off several branches, of which the following are the principal:—

1, 2. ARTERIÆ RECURRENTES, anterior and posterior, arise from the ulnar immediately below the elbow-joint; they sometimes arise by a common trunk, which soon subdivides; sometimes they arise distinctly. The anterior recurrent artery is the smaller of the two; it passes upwards beneath

the pronator teres muscle, on the anterior surface of the joint, and on the brachialis anticus muscle, to all of which it gives several branches; it anastomoses with the arteria anastomotica magna, and with branches from the inferior profunda. The posterior recurrent is an artery of very considerable size; it passes upwards and backwards beneath the ulnar nerve, behind the internal condyle, and between the two origins of the flexor carpi ulnaris; it gives several branches to this muscle, also to the lower part of the triceps, and to the synovial membrane of the elbow-joint, and in the fossa between the internal condyle and olecranon process, this artery terminates in a free inosculation with the inferior and superior profundæ and anastomotica magna.

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difficulty in restraining hæmorrhage, as mere pressure on the radial and ulnar arteries could not suffice. I have occasionally found this "median branch" to arise from the trunk of the brachial, or from the radial or ulnar artery.

A little above the styloid process of the ulna, the ulnar artery sends off two small branches, one to the back, the other to the front of the carpus, named accordingly:—

4, 5. ARTERIÆ CARPI ULNARES, ANTERIOR ET POSTERIOR; these arteries are similar in their course and termination to the corresponding branches of the radial artery, with which, and with the anterior and posterior interosseous arteries, they freely inosculate.

The ulnar artery, as it is passing over the annular ligament, continues to send off on either side small branches to the cellular membrane and integuments, and having arrived opposite the base of the metacarpal bone of the little finger, divides into two branches, namely, arteria communicans vel profunda, and arteria palmaris superficialis.

6. ARTERIA COMMUNICANS VEL PROFUNDA, passes backwards between the flexor brevis and abductor minimi digiti muscles, to which it gives many branches; it then joins the extremity of the arteria palmaris profunda, the last branch of the radial artery, and thus completes the deep palmar arch of arteries: this branch of the ulnar artery is accompanied by the larger division of the ulnar nerve.

7. ARTERIA PALMARIS SUPERFICIALIS runs obliquely across the palm of the hand towards the centre

of the digital nerves, are distributed to the cellular membrane and papillæ of the cutis.

As the digital arteries run along the sides of the fingers, they send several branches both before and behind the phalanges, which are surrounded by their inosculations: the synovial sheaths of the tendons, and of the several articulations, are supplied by these; near their termination several branches are sent to the back part of the last phalanx, which form a plexus of arteries in the cellular membrane and cutis beneath the nail.

The student may now consider in what situations the ulnar artery can be most easily exposed during life. In the superior third of the fore-arm, the great depth at which this artery lies from the surface, and the number of muscles which cover it, render it impracticable to expose it sufficiently to pass a ligature around it, without dividing the superficial muscles, and making a deep and difficult dissection through them; this practice, however, will be not only justifiable, but even necessary in cases of a recent wound in this situation, the enlargement of which, in the proper direction, will often suffice to enable the operator to expose the vessel. In the middle and inferior thirds of the fore arm, the artery is comparatively superficial, and the flexor carpi ulnaris muscle will serve as a guide to it.

A surgeon may be required to tie the ulnar artery in consequence of aneurism, or of a wound of the artery itself, or of any of its palmar branches.

The ulnar artery may be tied in the middle or lower third of the fore arm, by making an incision through

the integuments about three inches long, on the radial side of the flexor carpi ulnaris; the aponeurosis of the fore-arm is then to be divided in the same direction; the flexor carpi ulnaris, which in the middle of the fore-arm nearly covers the artery, is to be drawn inwards from the flexor sublimis; the deep layer of fascia being next divided, the ulnar artery and its accompanying veins are brought into view; the ulnar nerve is on their ulnar side; the veins are to be detached from the artery, and the aneurism needle should be passed under the latter from its ulnar to its radial side, avoiding the ulnar nerve, which, near the wrist, lies rather behind the artery. This operation will be facilitated by adducting the hand and wrist, the tendon of the flexor carpi ulnaris will be thus drawn inwards from over the artery. Near the carpus, the artery will be found nearer to the median line than to the ulnar border of the fore-arm.

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ARTERIA INTEROSSEA.

THIS artery, which was before mentioned as the third branch of the ulnar artery, arises from this vessel while covered by the pronator and superficial flexor muscles: sometimes, but very rarely, it arises from the brachial artery. It passes backwards, downwards, and a little outwards, towards the interosseous space, at which it arrives opposite the tubercle of the radius; it first sends off a few insignificant branches, named anterior recurrent arteries; these ascend towards the coronoid process of the ulna, assist in supplying the elbow-joint, and anastomose with the different branches before described in this situation. At the upper edge of the interosseous ligament, the interosseous artery divides into two branches, named the anterior and posterior interosseous arteries.

The *anterior* descends on the surface of the interosseous ligament, accompanied by a long branch of the median nerve, and covered by the flexor pollicis and flexor profundus muscles at their junction, and having arrived at the superior edge of the pronator quadratus muscle, it divides into two branches; one supplies this muscle, and descends in front of the carpal bones, on which it anastomoses with the anterior carpal branches of the radial and ulnar arteries, and with the deep palmar arch; the other, the larger branch, pierces the interosseous liga-

ment, descends along the posterior surface of the radius, and divides into a number of branches, which inosculate freely with the posterior carpal and posterior interosseous arteries.

The *posterior* interosseous artery passes to the back of the fore arm, through the interosseous space, between the upper edge of the interosseous ligament and the oblique ligament of the elbow-joint, and is covered posteriorly by the anconæus and extensor digitorum communis muscles: it immediately divides into two branches of nearly equal size: the ascending is named the posterior interrosseous recurrent; it lies between the anconæus and supinator brevis muscles, ascends between the external condyle and olecranon process to the triceps muscle, in which it anastomoses with the radial recurrent, musculo-spiral and posterior branches of the superior profunda, and sends branches towards the olecranon process, which meet some from the ulnar recurrent artery, with which they also inosculate.

The descending branch of the posterior interosseous artery lies more superficial than the anterior interosseous; it is not on the interosseous ligament, but runs between the divisions of the extensor digitorum communis, and of the extensors of the thumb; near the wrist it divides into three sets of branches; the middle anastomoses with the posterior branch of the anterior interosseous artery, the external with the arteria dorsalis carpi radialis, and the internal with the dorsalis carpi ulnaris. This artery is accompanied by the posterior interosseal nerve, a large branch of the

radial or musculo-spiral, which winds round the upper extremity of the radius, and the supinator radii brevis muscle.

In amputation of the fore-arm, in addition to tying the radial and ulnar arteries, the surgeon ought to search for the interosseous vessels, particularly the anterior, which lies concealed not in the centre of the interosseous space, but close to the radius. It often happens that the arteries of the fore-arm retract after amputation of the hand, and do not bleed; and I have heard many surgeons say, that they have performed this operation without tying a vessel, and that hæmorrhage did not follow: however, I would recommend in all cases, whether the arteries bleed or not, that they should be secured by ligatures.

The integuments of the palm of the hand are very vascular, and slight wounds in this situation often bleed profusely, not merely at the time of the accident, but they are peculiarly liable to secondary hæmorrhage. The structure of the parts, and the free anastomoses between the different arteries in the hand, may account for this; the density of the cellular tissue, and the numerous branches which each vessel gives off, serve to retain it in its situation, so that when an artery is divided it cannot retract so as to close itself, nor can an ecchymosis form around the divided vessels, in this situation, as easily as in other parts of the body.

In a simple incised wound of the palm of the hand there is often considerable difficulty in restraining hæmorrhage; when the surgeon examines the wound,

in order to secure the bleeding vessel, he can only observe that the blood appears to flow from several orifices, either in a continued stream or *per saltum*, but he cannot fix the tenaculum in any particular artery, neither does approximating the edges of the wound restrain the hæmorrhage; if he enlarge the wound with the intention of exposing the vessel, he only increases the difficulty, as in each attempt he will divide several others. In a wound in this situation, unless the surgeon can see any particular vessel bleeding, and so situated as to admit of a ligature being applied to it, he had better not use either the tenaculum or knife; and if approximating the edges of the wound, and making pressure by bandage and compress, fail in checking the hæmorrhage, he should then try graduated compression, first filling the wound from the bottom with a small piece of sponge, and laying over this small compresses, which are then to be secured by bandage. While the surgeon is applying these compresses, an assistant should compress the radial and ulnar arteries a little above the wrist, or put a tourniquet on the brachial artery. Should hæmorrhage even then supervene, the surgeon should tie one or both of the arteries of the fore arm, first endeavouring to ascertain from which of these arteries the divided vessel is derived; this may be conjectured from the situation of the wound, and from alternately compressing the radial and ulnar arteries: if the wound be on the ulnar side of the palm near the pisiform bone, there is almost a certainty that either the ulnar artery or some of its branches have been wounded, and in such a case

tying the ulnar artery, and making compression at the part, will, in all probability, prevent further bleeding. On the contrary, should the wound be near the thumb, or between the thumb and index finger, and if compressing the radial artery diminish or stop the flow of blood, the surgeon may expect that tying the radial artery and applying pressure on the wound may be attended with success; if, however, he find that tying one artery does not effect the object of commanding the flow of blood, he must then tie both arteries above the wrist, and even then it may happen that inosculations between the interosseous arteries or some large muscular branch, and the palmar arch, will permit the hæmorrhage to continue; this hæmorrhage, however, may, in all instances, be restrained by local pressure.*

* It is remarkable, that the free and deep incisions which we are frequently called upon to make into the palm of the hand, for abscesses arising from neglected paronychia, or other causes, are seldom followed by hæmorrhage.

GENERAL OBSERVATIONS.

THE student having now concluded the dissection of the arteries of the neck and superior extremity, may re-consider the various inosculations that exist between these vessels in the different regions of the neck, axilla, arm, fore-arm, and hand, and he may contemplate the chain of vascular communication extending from the shoulder to the fingers, so that if the main artery of the superior extremity be obliterated in any part of its course, he may comprehend those several links by which collateral circulation can be established; for it is well known that in a few hours after the operation of tying the principal artery, the pulse at the wrist may be distinctly felt.

This communication is maintained partly by distinct vessels, which are rendered obvious by dissection; such exist around the scapula and elbow, and in the hand; during life, however, there are numerous inosculations between small arteries from distant sources in the integuments and cellular membrane through the whole of the superior extremity, even on the periosteum, and within the bones; these inosculations the dissector seldom has an opportunity of observing, but they constitute a complete vascular tissue, extending from the shoulder to the fingers. Indeed, a careful dissection of the arteries of a limb, in which the main trunk has been for some time obliterated, clearly proves, that the anastomosing arte-

ries are derived not from any one particular series of vessels, but that they are supplied by every contiguous ramification. It cannot, however, be uninteresting to the student to reflect on those particular vessels which constitute the more obvious and direct media of communication, in case obstruction to the flow of blood exists in any part of the artery of the superior extremity. Suppose this obstruction to have occurred in the subclavian artery in the first stage of its course, and before it has given off any branch, the arm will be then indebted for its principal supply of blood to the following inosculations:—the vertebral artery, from its anastomosis with the opposite vertebral, and with the internal carotid arteries, will receive a considerable share of blood, which it will transmit into the subclavian beyond the obstruction; the inferior thyroid artery, from its free communication with the superior thyroid, will contribute to the same effect. But should the obstruction of the subclavian extend as far as the scaleni muscles, and have obliterated the mouths of all its large branches, then blood will be transmitted to the shoulder and arm through the inosculations of the superior thyroid, the occipital and muscular branches of the external carotid, with the ascending branches of the inferior thyroid, suprascapular and transversalis colli arteries, and through the descending branches of these three last named vessels, it will flow into the sub scapular, thoracica-acromialis, and circumflex, and thus be carried into the trunk of the axillary artery.

If the axillary artery be obstructed above the sub-

scapular and circumflex arteries, the inosculations around the scapula will be still more direct and free than in the case last supposed. But should the obstruction in the axillary artery include the origins of the subscapular and circumflex, collateral circulation will be then established not only throughout the inosculations around the scapula, but also through those which exist between the circumflex and subscapular arteries, and the branches of the profunda humeri, and through this last named vessel the blood will enter the trunk of the brachial artery. Suppose even that the obstruction extended through the axillary and brachial artery, and included the origin of the superior profunda, then the descending branches of this last named artery will conduct the blood into the recurrent branches of the radial, interosseous, and ulnar arteries; in such a case then, the circumflex, subscapular, and profunda, will transmit the blood from the cervical and scapular branches of the subclavian into the recurrent arteries from the fore arm.

The anastomosis between the arteries in the forearm are so free and frequent, that it is unnecessary to dwell on their capability to establish a collateral circulation in case one or both of these arteries be obliterated.

The communication between the different arteries in the hand and on each of the fingers, are so numerous and open, as in cases of wounds, to prove a source of danger to the patient, and of embarrassment to the surgeon. Both in the superior and inferior extremity, the further the anastomoses are removed from

the trunk towards the extremity of the limb, the larger and more manifest they become; these facts, as Professor Scarpa* observes, clearly show, that nature has provided amply for the ease and equable distribution of the blood through the extremities, not only by the numerous anastomoses, but also by forming these anastomoses the larger in proportion to the greater distance of the parts from the heart, and, therefore, the less the impetus which the blood receives from it.

From a review then of the arterial anastomoses in the neck and superior extremity, the student will, doubtless, come to the following conclusion, which that distinguished professor, whose words I have just quoted, has deduced from a careful observation of these inosculations, and with which I shall close this first part of the Surgical Anatomy of the Arteries:—

"If," says Scarpa, "we add to all these anastomoses existing among the arteries of the superior extremity, the almost innumerable communications which occur between the arteries of the common integuments and of the cellular substance, both sub-cutaneous and inter-muscular, through the long tract from the neck to the fingers, which arteries are derived from many origins, and constitute together a vast vascular plexus extended over the whole length of the superior extremity, the sum of the described anastomoses is so prodigiously increased, that no one who is acquainted

* See a Treatise on the Anatomy, Pathology, and Surgical Treatment of Aneurism, by ANTONIA SCARPA, translated by J. H. WISHART, page 48.

with this structure, would hesitate for a single moment to believe, that the artery of the superior extremity may be safely tied at any point, without any fear of destroying the circulation and life of the lower part of the limb. Ever since the art of injection was introduced into anatomy and cultivated, these arterial communications have been discovered to be very much extended, not only between the arteries of the distinct parts of each limb, but also between those of different divisions of the arterial system. To this system may be justly applied the saying of Hippocrates, *in toto corpore unus consensus et una conspiratio*; for it may be boldly stated, that the whole body is an anastomosis of vessels—a vascular circle."

END OF VOL. I.

THE

SURGICAL ANATOMY

OF THE

ARTERIES

OF

THE HUMAN BODY.

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91.

CONTENTS.

	Page.
DESCENDING AORTA,	1
THORACIC AORTA,	2
Bronchial Arteries,	6
Œsophageal Arteries,	10
Intercostal Arteries,	11
ABDOMINAL AORTA,	19
Operation of tying the Abdominal Aorta,	26
Cœliac Axis,	30
Gastric Artery,	31
Hepatic Artery,	32
Splenic Artery,	37
General Remarks on the branches of the Cœliac Axis,	42
Superior Mesenteric Artery,	45
Inferior Mesenteric Artery	50
General Remarks on the Mesenteric Arteries,	53
Phrenic Arteries,	56
Capsular or Atrabiliary Arteries,	58
Renal or Emulgent Arteries,	ib.
Spermatic Arteries,	60
Remarks on the Operation of Castration	62
Lumbar Arteries,	65
Middle Sacral Artery,	67
COMMON ILIAC ARTERIES,	69
INTERNAL ILIAC OR HYPOGASTRIC OR UMBILICAL ARTERY,	70
Operation of tying the internal Iliac Artery,	73

Page.

Ilio-lumbar Artery, ... 78
Lateral Sacral Artery, ... 80
Middle Hæmorrhoidal Artery, ... 81
Vesical Arteries, ... 82
Umbilical Artery, ... 83
Uterine Artery, ... 84
Vaginal Artery, ... 85
Thyroid or Obturator Artery, ... ib.
Remarks on Femoral Hernia, ... 89
Gluteal Artery, ... 90
Operation of tying the Gluteal Artery, . . . 95
Ischiadic Artery, ... 96
Operation of tying the Ischiadic Artery, . . 99
Internal Pudic Artery, ... 100
External Hæmorrhoidal Arteries, . . . 109
Perinæal Artery, ... 110
Transverse Perinæal Artery, ... 111
Artery of the Corpus Spongiosum Urethræ, . . 112
Observations on Lithotomy, ... ib.
Artery of the Corpus Cavernosum Penis, . . 115
Dorsal Artery of the Penis, ... ib.
EXTERNAL ILIAC ARTERY, ... 119
Epigastric Artery, ... 122
Observations on Inguinal Hernia, . . . 125
Circumflex Ilii Artery, ... 126
Operation of tying the external Iliac Artery, . . 129
FEMORAL ARTERY, ... 133
Superficial Epigastric Artery, ... 142
Superficial or external Pudic Arteries, . . . 143
Superficial Circumflex Ilii Artery, . . . 144
Arteria Profunda Femoris, ... ib.
External Circumflex Artery, ... 147
Internal Circumflex Artery, ... 149
First Perforating Artery, ... 152
Second Perforating Artery, ... ib.

Page.

Third Perforating Artery, ... 153
Anastomotica Magna, ... 155
Operation of tying the Femoral Artery, . . 156
'OPLITEAL ARTERY, ... 167
Operation of tying the Popliteal Artery, . . 173
'OSTERIOR TIBIAL ARTERY, ... 177
Peronæal Artery, ... 179
Operation of tying the posterior Tibial Artery, . 182
Internal Plantar Artery, ... 188
External Plantar Artery, ... ib.
NTERIOR TIBIAL ARTERY, ... 193
Recurrent Branch, ... 195
Malleolar Arteries, ... 196
Tarsal Artery, ... 197
Metatarsal Artery, ... ib.
Operation of tying the anterior Tibial Artery, . 193
General Observations on the Arteries of the inferior Extremity, ... 200

SURGICAL ANATOMY

OF THE

ARTERIES.

AORTA DESCENDENS.

THE aorta, from the termination of its arch, descends along the left side of the dorsal vertebræ to the diaphragm, between the crura of which it passes into the abdomen, and descending as low as the fourth or fifth lumbar vertebra, it divides into the right and left iliac arteries.

The course of this vessel from the fourth dorsal to the fourth lumbar vertebra is not in a straight line, but is very much curved, the convexity to the right, the concavity to the left side; in the upper part of the thorax the artery lies to the left side of the spine; on the twelfth dorsal vertebra it is nearly in the mesial line, while on the lumbar vertebræ it inclines a little to the left side. The descending aorta is also concave forwards in the thorax, and convex forwards in the abdomen, being thus accommodated to the form

of the anterior surface of the spinal column, to which it is applied.

The passage of the aorta through the diaphragm affords a good opportunity for dividing this vessel into two parts, viz. the superior or thoracic, and the inferior or abdominal portion; the latter is shorter and smaller than the former. It is immaterial to which of these the dissector first directs his attention.

AORTA THORACICA.

To expose the thoracic aorta, the student should lay open the cavity of the thorax, at least on the left side; the sternum and costal cartilages having been removed, the ribs of this side must be divided with the saw, near to, or behind their centre, (a block being placed beneath the dorsal vertebræ,) the pericardium, heart, and left lung, are then to be drawn over to the right side, and thus the posterior mediastinum will be exposed, in which region the aorta and œsophagus may be discerned through the pleura.

The posterior mediastinum is described in anatomical writings as a space of a triangular figure, extending from the third to the tenth dorsal vertebra, the sides of this space formed by the two pleuræ, the base by the vertebræ, and the apex by the approximation of the pleuræ on the posterior surface of the pericardium, and by this membrane also. This description is too mechanical, the posterior mediastinum has no very accurate form, the serous membranes are not tense along its sides, as they appear to be when the

lungs are drawn forwards, but each pleura is folded upon the organs in front of the vertebræ, so that the aorta is nearly enveloped by these membranes, which approach each other in front of it, and behind the œsophagus, almost surrounding that tube also, with which however they are more loosely connected than with the aorta. In this region are contained the œsophagus and aorta, the vagi and splanchnic nerves, (the sympathetic nerves are not properly in this space,) the thoracic duct, vena azygos, several lymphatic glands, and a considerable quantity of cellular membrane.

As the student proceeds in exposing the thoracic aorta, he will find that this vessel is covered by the left pleura through its whole course, and that the left bronchial tube, the root of the left lung, the left auricle of the heart, and the pericardium, are all anterior to it. The œsophagus, with its accompanying nerves, (the vagi), crosses the aorta obliquely, for the former in its descent inclines from the mesial line to the left side, whereas the aorta advances from the left to the front of the spinal column; accordingly, in the upper part of the posterior mediastinum, the œsophagus is on the right side of the aorta, between it and the right pleura: in the middle division of this region it is in front of the artery, between it and the pericardium: and inferiorly it is on its left side but on a plane anterior to it.

The thoracic aorta lies very near the vertebral column, separated from it only by some cellular membrane, by the commencement of the intercostal arte-

ries, and by the intercostal veins of the left side, in their course to join the vena azygos. The splanchnic nerves are on each side of the aorta; that on the left side is close to it, and frequently passes through the diaphragm by the same opening as the artery, or separated from it only by a few fibres of the muscle.

The anomalies which have been observed in this portion of the arterial system, have been already noticed in the commencement of the first part of this work.

Before the student proceeds to examine the branches of the thoracic aorta, he should reflect on the effects which disease of this part of the arterial system is likely to produce on the surrounding parts. We know that aneurism may form in any part of the thoracic aorta, and we may expect, that, in consequence of the great distance of the artery from the surface, and its contiguity to several organs, the symptoms of this disease shall be sometimes very obscure, and liable to be mistaken for those of other affections. Aneurism of the thoracic aorta may extend into the posterior mediastinum, press against the œsophagus, and cause pain and difficulty in swallowing, as in stricture of that tube; or by pushing forward the heart, it may give rise to symptoms resembling those attending some of the diseases of that organ; the aneurismal sac may be directed backwards towards the vertebræ, and induce absorption or caries of their bodies and curvature, with pain and weakness of the spine and extremities; while the tumour protruding the integuments on either side of the

spine, may assume the appearance of an abscess connected with diseased bone. If the disease incline to either side, it may press upon the lung, produce irritation and pain in that organ, pain in the side and difficult respiration, with frequent cough, so as to resemble phthisis: in many cases, however, the expectoration in these diseases differs essentially, being thin and frothy in cases of aneurism, and viscid mucus, or purulent, in diseased lungs.

Aneurism of the thoracic aorta may burst into the lung, into the cellular membrane in the posterior mediastinum, into the œsophagus, or into the cavity of the pleura, particularly into that of the left side: it will open into the mediastinum or œsophagus by the process of sloughing; but when the pleura becomes stretched over the aneurismal sac, that membrane tears or cracks suddenly. Sometimes an aneurismal tumour which has formed at the upper part of the thoracic aorta, will dissect its way down for some distance along the vessel between its cellular and middle coats, and may then burst into the mediastinum, or again form a communication with the cavity of the artery.

From the thoracic aorta several branches proceed, which, however, are so small, that when this trunk has arrived at the diaphragm it is not sensibly diminished in magnitude; some of these branches supply the viscera, others the parietes of the thorax. The branches of the thoracic aorta, though not remarkable for their size, are yet worthy of notice; they may be divided into two orders, namely, those arising

from the front and those from the back of the aorta; the former are the bronchial and œsophageal, also small branches to the pericardium and posterior mediastinum: the latter are the intercostal arteries.

The student should dissect the anterior branches first; those to the pericardium and mediastinum are so insignificant in size, and so uncertain as to their origin, or even as to their existence, as not to require any particular description.

ARTERIÆ BRONCHIALES.

THE bronchial arteries are generally believed to be the nutritious arteries of the lungs; they receive their name from the bronchial tubes which they accompany through these organs; in number and in magnitude they are very irregular, as well as in the situation of their origin; some anatomists enumerate four, and others only two. They may be distinguished by the names of the superior and inferior, right and left bronchial arteries.

These four arteries arise from the aorta, sometimes distinctly, and sometimes by two or three, or even by one common trunk.

The *superior bronchial arteries* arise either in common or separately from the anterior part of the aorta, opposite the fifth or sixth dorsal vertebra; (the superior bronchial of the right side often arises from the first intercostal artery;) they soon separate, and pass towards either lung, giving off small branches to the left auricle of the heart, to the pericardium, the bron-

chial glands, œsophagus, and cellular membrane in the posterior mediastinum. These arteries then attach themselves to the posterior surface of the bronchial tubes, and twining round these vessels, accompany them into each lung, where they divide into four or five branches, which soon subdivide into numerous ramifications, to supply the bronchial tubes and the cellular tissue of the lungs.

The *inferior bronchial artery* or *arteries* arise a little lower down than the last, and are distributed in a similar manner; they are usually larger than the superior. The bronchial tubes frequently receive additional arteries from the internal mammary or from the subclavian arteries.

The minute branches of the bronchial arteries are thought, by some anatomists, to inosculate with those of the pulmonary artery; the anastomosis between these vessels is delineated by Ruysch and Cowper, as being very distinct and free; this communication is the more remarkable, as these arteries are supposed to differ not only in their functions, but also in the qualities of the blood which each contains, it being bright red or arterial in the bronchial, but dark purple or venous in the pulmonary arteries.

Some anatomists have asserted that the bronchial arteries communicate with the pulmonary veins; such an anastomosis appears a remarkable exception to the general laws of the circulation, which require that all the blood should pass through the pulmonary circulation before it enters the aorta; but if the communication just alluded to exist, a quantity of blood must be

returned from the bronchial arteries, by the pulmonary veins, to the left side of the heart, without having previously passed through the pulmonary artery.

Winslow has observed one of the bronchial arteries to terminate in the vena azygos, (*Anatomie du Corps humain*, sect. IV. p. 113.) Portal, with the right coronary vein of the heart, (*Cours d'Anatomie Medicale*, tom. III. p. 254.)

In the *Journal de Medicine*, (*Pluviose, an.* 10.) a case is recorded of a large artery arising from the abdominal aorta, near the cœliac axis, and entering the thorax by the side of the œsophagus, it then divided into two branches, one to supply the inferior lobe of each lung; in the substance of which its branches anastomosed freely with the superior pulmonary arteries. The pulmonary veins were regular. This singular case ought perhaps to be considered rather as an irregularity in the pulmonary artery, which only supplied the superior lobes of the lung, than in the bronchial arteries, although the anomalous vessel arose from the aorta.

I have injected the bronchial arteries in several subjects; in some few cases, where the fluid was very fine, it entered the pulmonary arteries; I have never been able, however, to see the inosculating branches, as delineated by Ruysch, nor could I affirm whether the injected fluid passed through continuous tubes, or whether the communication between these vessels had not been opened by a rupture of both. I have never been able to inject the bronchial arteries from the pulmonary artery, the fluid has in every instance returned

by the pulmonary veins, and if much force had been used, it has entered the air tubes.

Although I have never succeeded in filling the bronchial veins from the bronchial arteries, yet, judging from analogy, I think there can be no doubt of a communication existing between these vessels. When I reflect on the small size of the bronchial arteries, compared with the organs they supply, as well as their irregularity in situation and in origin, I cannot altogether concur in the opinion that these are the only nutritious vessels which the lungs possess; this is a subject which cannot be decided by any accurate or unobjectionable experiment; yet, it does not appear to me why the pulmonary artery may not convey blood to the lungs for the double purpose of its purification, and for their supply; that one artery can accomplish the twofold office of secretion and of nutrition may be inferred from observation of different glands, as the kidney and testicle: in each of these organs one artery must effect both processes; and in the skin, which performs a function very similar to that of the lungs, we have every reason to believe that the ramifications of the same arteries not only nourish this tissue, but also secrete or exhale the peculiar fluid of perspiration. It is objected to the pulmonary artery having the property of supporting the lungs, that it conveys venous blood, which in no other tissue is supposed to possess the qualities necessary for nutrition; to this, however, we may reply, that the blood in the pulmonary artery, though of venous colour, has just received the chyle, that material on which the nourishment and repairs of

the whole system must depend. Neither is there any proof that the vena porta is merely a vessel for secretion.

When the pulmonary artery is injected minutely, the whole lung, particularly the mucous membrane lining the bronchial cells and vessels, is deeply tinged with the coloured fluid; not so if the bronchial arteries be injected, they in general do not admit a sufficient quantity of the injection, to alter the colour of the lung, unless the fluid shall have passed into the branches of the pulmonary artery, and then the same effects will be produced as if the fluid had been forced from the trunk of that vessel itself. The bronchial arteries are not found enlarged in cases of long continued inflammation, which has condensed or altered the structure of the lung, or of its serous membrane, or produced adhesions between the pleura pulmonaris and costalis; and in such cases the parts so affected, as well as any new membrane which may have been formed by the adhesive process, can be injected from the pulmonary artery.

ARTERIÆ ŒSOPHAGEÆ

Are uncertain in number, size, and situation; sometimes there is but one, and that of considerable size; sometimes several small arteries arise from the aorta distinctly, and sometimes they are all derived from the bronchial arteries; the œsophageal arteries ramify on the muscular parietes of the œsophagus, and on the surrounding cellular membrane: some branches as-

cend, and inosculate with the inferior thyroid arteries; others descend towards the diaphragm, and join with branches from the phrenic and gastric arteries. The arteries of the œsophagus are principally distributed along with the branches of the surrounding plexus of nerves to the muscular, and not to the mucous coat of the œsophagus; accordingly the lining membrane here is not so vascular or sensible as in other parts of the digestive canal. On the parietes of the œsophagus, the student may trace a chain of communication between the arteries of the neck, thorax, and abdomen, the links of which are the thyroid branches of the carotid and subclavian arteries, and the œsophageal and gastric branches of the thoracic and abdominal aorta. Winslow has observed a communication between one of the œsophageal arteries and one of the pulmonary veins.

ARTERIÆ INTERCOSTALES.

THE aortic intercostal arteries are generally nine in number on each side; there are sometimes ten, and sometimes only eight; this variety depends on the size of the superior intercostal arteries, which may supply one or three intercostal spaces; not unfrequently there are ten aortic intercostals on the left, and only eight on the right side. Sometimes two or three intercostal arteries of one side will arise by a common trunk, this is more frequently observed in the inferior portion of the series, and is analogous to the

arrangement in the two or three first intercostal spaces.

All these arteries are so nearly similar in their origin, course, and termination, that one description may apply to all. The student should select one or two of the largest, and by making a careful dissection of these, he may acquire a sufficiently accurate knowledge of the whole class.

The intercostal arteries take their origin from the posterior part of the aorta, those of opposite sides arise very near each other, sometimes by a common trunk: each artery then ascends obliquely, passing at the same time backwards and outwards, in a groove on the side of each vertebra, and arriving at the intercostal space, it divides into a posterior and anterior branch. The superior aortic intercostal arteries ascend very obliquely, the middle less so, and the two or three inferior are nearly transverse. There is no essential difference between the intercostal arteries of the right side, and those of the left; the former are somewhat longer, and cross the spine behind the vena azygos and thoracic duct. The intercostal arteries of each side are covered by the pleura, and they all pass behind the sympathetic nerve and its ganglions. As the intercostal arteries pass by the sides of the bodies of the vertebræ, they send several branches to these bones and to the parts in the posterior mediastinum; at the head of every rib each artery sends off ascending and descending branches, which inosculate with corresponding branches from the artery above and below; in like manner, the first aortic intercostal anas-

tomoses with the superior intercostal from the subclavian artery, thus preserving a communication between the arteries of the neck and those of the thorax.

If the aorta were obliterated at the inferior extremity of its arch, this anastomosis would assist in conveying blood from the subclavian artery into the descending aorta. A case in which this actually occurred is recorded in the 5th vol. of the Med. Chir. Transactions.* The posterior branch of each intercostal artery is smaller than the anterior, it escapes from the thorax through an opening which is bounded internally by the vertebræ, and externally by the costotransverse ligament; it first gives off two or three branches, which enter the spinal canal by the intervertebral foramen; these assist in supplying the vertebræ, the spinal marrow, and its membranes; the posterior branch having arrived in the fossa between the spinous and transverse processes of the vertebræ, divides into a great number of branches; some are very short and are distributed to the sacrolumbalis, longissimus and spinalis dorsi muscles; others are very long and pass towards the scapula, supplying the trapezius, latissimus dorsi, and rhomboid muscles and the integuments, and they ultimately anastomose with different arteries at the base of the scapula.

The anterior branch of each intercostal artery is much larger than the posterior, appears to be the continued trunk, and is the proper intercostal vessel.

* A similar case is recorded by Dessault: (Journal, 1789.) See also Guthrie on Diseases and Injuries of Arteries, p. 354.

Each of these arteries passes upwards and outwards, and, near the angle of the rib enters the groove in its inferior edge, and is thus conducted round the parietes of the thorax, between the laminæ of the intercostal muscles and at the upper part of each intercostal space; in this course the artery lies close to the bone, and much nearer to the pleura than to the integuments; the student may expose it either from within, by raising off the pleura, or from without, by dividing the different muscles which occupy the intercostal space.

Each intercostal artery is accompanied by a nerve of considerable size, and by one or two veins which lie superior to the artery. As the artery proceeds, it gives several branches to the intercostal muscles and to the pleura, also to the muscles on the parietes of the thorax; some of these branches anastomose with the thoracic arteries, particularly in the axilla: about the centre of the rib the artery usually divides into two branches, an inferior small one runs along the superior margin of the inferior rib, and supplying the intercostal muscles is lost on the external surface of the rib; the other, or superior branch continues in its original direction along the superior rib as far as its cartilage, and there descending a little, it meets a branch from the mammary artery. The inferior intercostal arteries send branches to the crura of the diaphragm, to the quadratus lumborum, and to the abdominal muscles; these arteries anastomose with the phrenic, lumbar, and epigastric.

If the student have an opportunity of dissecting the

arteries of the thorax in a very well injected young subject, he will find numerous anastomoses to exist in the parietes of this cavity; at each side of the spine the posterior branches of the intercostal arteries communicate freely with each other, and with descending branches from the cervical arteries, with the arteries about the scapula, and with the posterior branches of the lumbar arteries. On the sides of the thorax, the intercostal vessels have free and frequent inosculations with the thoracic branches of the axillary artery, and anteriorly each intercostal is joined by a branch of the mammary.

A considerable quantity of blood must circulate in the parietes of the thorax, and branches from the same arteries supply the integuments, muscles, and serous membranes; this may account for the sympathy between the integuments of the thorax and its lining membranes, as is exemplified in the effects of cold, which, when applied to the surface, often excites irritation and disease in the pleura, while again local bleeding, blisters or any other counter-irritants are among the most certain means of relief in cases of internal inflammation.

The intercostal arteries may be wounded by a spicula of a fractured rib, or in cases of wounds which penetrate the cavity of the thorax; also in the operation of paracentesis of the thorax, or in opening an hepatic abscess which points at an intercostal space. In case of a wound of the thorax, in which an intercostal artery has been opened, the patient may lose a considerable quantity of blood before the surgeon can

stop the hæmorrhage, the artery lies so deep, and the intercostal space is so confined, that it is almost impossible to hold the artery with the tenaculum or forceps, for the purpose of applying a ligature upon it. The student may form some conception of the difficulty of this operation, if he expose an intercostal artery in the dead subject by dissecting from the surface; this may also lead him to reflect on the plans which have been proposed for securing this vessel, when a ligature cannot be directly applied; he may endeavour to pass a small curved needle round the artery, directing it from within outwards: and should this measure be attended with much difficulty, from the smallness of the incision, he may observe how much it will be facilitated by enlarging the opening. Suppose it were impracticable to pass a ligature round the artery in the living subject, he may from this dissection learn the possibility of compressing it, by introducing a piece of sponge, with ligatures attached to it, into the thorax, and by drawing these outwardly, press the vessel against the bone; graduated compresses may be then applied over these, and the ligatures secured externally round a quill or bougie or by adhesive plaster; this plan I think will appear preferable to that of passing a ligature or wire round the rib, and so including not only the artery, but also the bone, and different soft parts. The proposal also of applying and securing metal or ivory plates on such a moveable part as the rib, appears objectionable as the attempt must be attended with considerable difficulty and inconvenience.

Where the surgeon is required to open any of the intercostal spaces, either in case of empyema or abscess of the liver pointing between the ribs, he should be particularly careful to avoid injuring the intercostal artery, or any of its large branches; the trunk of the artery is easily avoided by directing the flat trochar or lancet towards the inferior rib; but there is considerable difficulty in avoiding the branches which in these chronic diseases are often increased in size. If the operation be performed with the trochar, this instrument may only wound these vessels; or should it completely divide them, they may retract beneath the muscles, and bleed but little at the time of the operation; but when the patient has recovered from the first effects of the operation, and has become warm in bed or if he make any exertion, he is soon overcome with fainting and an alarming sense of weakness, yet no blood appears through the dressing, because it more readily flows into the cavity of the abscess where there is free space to receive it; this tendency to hæmorrhage may continue, and will return on the slightest exertion; and thus, in a very few days reduce the patient's strength to the last extremity. Hæmorrhage in such cases is very distressing and alarming; it is often impossible, when the wound is re-opened to see any particular vessel; and the parts are so tender and irritable from previous distention and disease, that compression or styptics are almost insupportable; and although they may for a time command the hæmorrhage, yet they will soon be followed by sloughing and fresh bleeding which will exhaust

and destroy the patient. In performing the operation in the first instance, the surgeon should not only divide the integuments with the knife, but also cautiously dissect through each layer of muscles, until the pleura or the wall of the abscess be distinctly seen or felt, and should any vessels be divided in this stage of the operation, they should be secured before the sac is opened, which may be done either with a lancet or with a flat trochar, which is much to be preferred to one of a triangular figure.

AORTA ABDOMINALIS.

To expose this artery, the abdominal muscles and peritoneum must be divided from the sternum to the pubes, and from the umbilicus to each os ilium; the three last ribs on either side may be sawed through about their centre, and everted; this will admit of the epigastric region being fully expanded, and of the viscera being separated from each other; a block should be placed beneath the last dorsal vertebræ. The less the peritoneum and its different duplicatures are injured, the better view will the student obtain of the relative anatomy of the aorta and of its branches; most of which can be exposed by dividing one lamina only of the processes of that membrane, and by moving the viscera in such directions as their loose connexions will permit; first divide the lesser omentum, but avoid injuring the gastric arteries, draw down the stomach towards the left side and then, by dissecting through some cellular membrane and nerves, the commencement of the abdominal aorta and the origin of some of its principal branches may be exposed; next, raise the stomach and great omentum (having first separated the latter from the colon) towards the chest, and the cavity of the epiploon being thus opened, dissect through the ascending layer of the mesocolon, this will expose the pancreas and duodenum; and by separating these, the aorta will be again seen; lastly, by elevating the transverse colon and mesocolon to-

wards the thorax, and by drawing down the mesentery towards the right side, the continuation of the aorta may be discerned through the peritoneum, which is stretched over it in a very tense manner, and by dividing this the artery will be perfectly exposed even to its division.

The aorta extends nearly in a straight line from the opening between the crura of the diaphragm to the fourth or fifth lumbar vertebra, where it divides into the right and left iliac arteries; behind the lesser omentum it lies in the mesial line, but as it descends it inclines a little to the left side; it rests upon the bodies of the lumbar vertebræ and is therefore convex forwards, its greatest convexity is on the third vertebra, that is a little superior and to the left side, of the umbilicus.

The abdominal aorta is covered by the following parts: first, by the lesser omentum and stomach, behind which are the branches of the cœliac axis of arteries, and the solar plexus of nerves; opposite the upper edge of the second lumbar vertebra, the artery is covered by the vena porta and mesenteric vessels, in front of which is the pancreas; inferior to these the duodenum passes across the aorta, separated from it by the left emulgent vein; (this vein in a few instances I have seen pass behind the aorta;) inferior to the duodenum the aorta is covered by the transverse mesocolon, and then by the root of the mesentery; and from this to its division it is covered by one lamina only of the peritoneum, and by the convolutions o. the small intestines.

The aorta does not descend abruptly from the thorax into the abdomen through a well defined opening in the diaphragm; on the contrary, it passes gradually behind the crura of that muscle, close to the vertebræ and is contained in a tendinous canal, about an inch in length, in which situation the artery (accurately speaking) is neither in the thorax or abdomen, but behind and between both cavities. This opening for the passage of the aorta is of a semilunar form, its edges are tendinous, so that the action of the muscle cannot affect the vessel; it is bounded laterally by the crura of the diaphragm, superiorly and anteriorly, by their connecting fibres and posteriorly by the last dorsal vertebra, which is covered by a ligamentous substance partly derived from the tendons of each crus turning in a little behind the artery: this opening is much larger than the aorta, and contains a quantity of cellular membrane, which connects the peritoneum and pleura to each other. The thoracic duct also and vena azygos pass through this opening, and lie between the aorta and the right crus of the diaphragm.

The œsophageal opening in the diaphragm, (the edges of which are muscular,) is to the left side of that for the aorta, and on a plane anterior and superior to it, the cardiac orifice of the stomach being opposite the left side of the ninth or tenth dorsal vertebra; these openings are separated by the decussating fibres which pass from one crus of the diaphragm to the other.

The large tendinous opening in the diaphragm for the passage of the vena cava, is to the right side and

anterior to that for the aorta, it is opposite to the right side of the tenth dorsal vertebra. The splanchnic nerves, expanding into the semilunar ganglions, lie on either side of the aorta as it enters the abdomen; the ganglion of the left side passes somewhat in front of this vessel, and is united to that of the right side by numerous nerves, which form the solar plexus: this plexus covers the aorta and surrounds the cœliac axis, and its branches accompany those of the aorta.

The abdominal aorta is accompanied by the vena cava, which lies to its right side is in contact with and partly covers it from the fifth to the second lumbar vertebra; the vein is then separated from the artery by the right crus of the diaphragm, and by the middle or spigelian lobe of the liver.*

The sympathetic nerves run parallel to the abdominal aorta, that of the left side is much nearer to the artery than the right, they are both, however, separated from it superiorly by the crura of the diaphragm, between which and the psoas magnus they are im-

* In the dissecting room, I lately met with a singular deviation from this (the usual course) of the vena cava; the subject was an old female; in it the two iliac veins united on the left side of the aorta on the fifth lumbar vertebra, the vena cava thence ascended on the left side of the artery; and opposite to the second vertebra, the vein was very much dilated, and passed over the aorta to its right side, and then entered as usual the groove in the right lobe of the liver; the femoral and iliac vein of the left side lay on the iliac side of their accompanying artery. I made a preparation of this singular variety, and have placed it in the museum of the School of Surgery.

bedded; the thoracic duct lies to the right side of the aorta above, but the commencement of this canal in the receptaculum chyli, is on the third or fourth vertebra behind the artery.

Before the student proceeds to a minute examination of the branches of the abdominal aorta, he should again consider the relation which this artery bears to the numerous viscera of the abdomen, the depth at which they lie from the surface, as well as the thickness and nature of the parts through which, in cases of disease, an examination in the living body is to be made. If we reflect a little on these circumstances, we shall be able to account for the difficulty that is often experienced in discriminating between aneurism of any of the principal arteries in the abdomen, and organic disease of any viscus in their vicinity. Aneurism is often found to occur in the abdominal aorta near the cœliac axis, sometimes in this short trunk itself or in one of its branches; and sometimes in the superior mesenteric artery. Suppose this disease exists in any of these vessels the stomach will suffer more or less inconvenience, slight perhaps at first, as in ordinary dyspepsia, but in proportion as the tumour increases in size, the functions of this organ will become more deranged and sickness and vomiting will be induced whenever it is distended by food; the situation and extent of this viscus and the great distance of the aorta from the surface in this part of the abdomen render it, in some cases almost impossible by an examination even the most careful, to decide on the exact nature of the disease. The pulsation is some-

times diffused, and appears to effect the whole epigastric region, as in some cases of flatulence and dyspepsia in very nervous or hypochondriac habits, where there is no disease in the arterial system. I may observe, however, that aneurism may in general be distinguished from that pulsation, which is often so remarkable in these constitutions; the pulsation in aneurism is strong and regular, synchronous with the pulse, and made more distinct by pressure; the pulsation in dyspepsia is irregular and unequal, is increased at one time, and is almost imperceptible at another; it is not synchronous with the pulse, but has more of a fluttering motion; when strong pressure is made upon the part affected, the pulsation soon ceases, nor does it immediately recur on removing that pressure; neither does the pulsation always return exactly in the same place.

Aneurism in any of the situations just mentioned, may burst into the stomach or duodenum, into the cellular membrane about the spine, into the cavity of the peritoneum, or between the laminæ of any of its processes. If the pyloric extremity of the stomach be enlarged, and connected by adhesive inflammation to the parts behind it, the pulsation of the aorta may be communicated to it, and may so give rise to symptoms resembling aneurism; in like manner diseased pancreas, tumours in the omentum or mesentery, or enlarged lymphatic glands, may have a pulsation communicated to them from this large artery as it rests against the spine, and this pulsation be perceptible through the abdominal parietes.

Having considered the several relations of this artery to the viscera in the abdomen, the student cannot fail to remark that, in making an examination of the living body, to ascertain the exact nature or situation of any disease, the position of the patient should be particularly attended to; that it will be necessary to have the abdominal muscles relaxed, and that by changing the posture of the patient from the horizontal to the sitting or erect or even bent forward or inclined to one side, he may be enabled to ascertain whether the pulsation of the tumour is diminished or increased by these changes of position; whether it is circumscribed, or confined to the line of the artery, or diffused according to the form of any particular viscus; whether the pulsation be synchronous with the pulse at the wrist, or rather an undulatory motion, synchronous with inspiration and expiration, as is sometimes observable in the vena cava below the liver, in diseases of that organ, or in nervous temperaments.

Aneurism of the abdominal aorta sometimes arises from the back part of the artery, and extends laterally and posteriorly towards the psoas muscle, and as it increases in size, it causes the absorption of this muscle and of the lumbar vertebræ; it then may press on the lumbar plexus of nerves, and cause weakness and paralysis of the lower extremities, and pain in the loins, as in psoas abscess; the tumour may also protrude backwards, and resemble an abscess connected with diseased bone.*

* I recollect a remarkable case of this kind which occurred many years since, and which I had an opportunity of examining

In very thin persons, if the abdominal muscles be relaxed, the aorta may be felt pulsating a little above, and to the left side of the umbilicus; in wounds of the abdomen, in which the aorta or common iliac artery has been injured, or in case of hæmorrhage from the bursting of an iliac aneurism, life may be suspended by making strong and steady compression on this part of the artery; and we can conceive a case in which a surgeon would be justified, even in opening the abdomen, and passing a ligature round the aorta itself. *Sir A. Cooper* has related a case of hæmorrhage, caused by the sloughing of a large aneurism of the left external iliac artery, in which he performed this operation, and which had the desired effect of protracting life for a period of forty hours; in this singular case, we find too, that the circulation was maintained in the lower extremity of the opposite side, although the main artery was obliterated. The abdominal aorta has been also tied, but with the same result, by Mr. James of Exeter, in a case of unsuccessful operation on the internal iliac artery.

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after death; in was in St. Thomas's Hospital, under the care of my much esteemed friend, Mr. Travers; the patient had most of the symptoms of psoas abscess, a fulness was perceptible in the lower part of the right side of the abomen, a tumour was also observed posteriorly at the right side of the spine; there was no pulsation in it that could be perceived through the parietes of the abdomen; the patient had suffered from it for more than four years, and yet there was but little swelling or distention in any direction; dissection shewed it to be an aneurism of the abdominal aorta, while it thus had greatly the appearance of psoas abscess during life.

Although we can scarcely hope for success from an operation so formidable in execution, and hazardous in its consequences, as that of tying the abdominal aorta; yet, when we consider that by it we may be enabled to avert immediate dissolution, and so perhaps secure incalculable benefit to the sufferer or his friends, we may justly regard this bold attempt of modern surgery, as worthy the attention of the surgical anatomist. In both cases of this operation above alluded to, the peritoneum was opened, in order to expose the aorta; as however it appears that a ligature may be placed upon this vessel by the same steps as are pursued in tying the external and the common iliac arteries, I shall defer any further remarks upon this subject, until I come to speak of the surgical anatomy of those vessels.

From the abdominal aorta several branches arise; they supply the diaphragm, the liver, spleen, pancreas, and all the alimentary canal, also the kidneys, testes, or ovaria, and the posterior and lateral parietes of the abdomen. The student may arrange these branches into two sets, namely, those from the anterior and those from the posterior part of the aorta; the former are nine in number four of which arise in the epigastric region, and five in the lumbar; those which arise in the epigastric region, are the two phrenic arteries, the cœliac axis, and superior mesenteric. The phrenic arteries supply the diaphragm; the cœliac axis supplies the great viscera in this region, viz., the liver, spleen, and stomach; the superior mesenteric is distributed to all the small intestines except the duode-

num, and to all the large intestines except the left descending colon and rectum. The branches which arise from the aorta in the lumbar region are the two renal arteries, the two spermatic arteries, and the inferior mesenteric artery. The renal arteries supply the kidneys, and their appendices the renal capsules; frequently small branches, named the capsular arteries, arise from the aorta, some above, and some below the renal artery; the former supply the renal capsules, the latter the ureters and surrounding cellular membrane; the spermatic arteries supply the testes or the ovaria; and the inferior mesenteric artery supplies the left decending colon, the sigmoid flexure and the rectum. The posterior set of branches of the aorta, are the four or five pair of lumbar arteries which supply the muscles of the posterior and lateral regions of the abdomen; and the middle sacral artery, which is distributed to the ligaments and muscles on the anterior surface of the sacrum.

The branches of the abdominal aorta are extremely irregular in their number and in the situation of their origin; the following is the order in which they most frequently arise, and may be considered the regular order, if such a term can properly be applied to a series of branches which present greater varieties in every respect than any other arteries in the body. The phrenic arteries are the first; the cœliac axis arises next; immediately below which is the superior mesenteric; about half an inch lower down are the renal arteries; and immediately below these are the spermatic; about an inch and a half or two inches be-

low the renal, and about half an inch above the division of the aorta, the inferior mesenteric artery arises; the lumbar arteries proceed from the back of the aorta, opposite each lumbar vertebra, and the middle sacral arises also from its posterior part, about a quarter of an inch above its division. I shall mention the most common deviations from this order in describing the individual arteries.

Thus the abdominal aorta, like the thoracic, supplies the parietes of the cavity through which it passes, as well as the viscera which that cavity contains; in the thorax, however, the branches to the parietes are many and large, and those to the viscera small and few, whereas in the abdomen, the visceral branches are large and numerous, but those to the parietes are inconsiderable.

I do not recommend the student to trace the branches of the aorta according to the order in which they arise, or as I have arranged them above; he had better first examine the three great vessels (viz., the cœliac axis, the superior and the inferior mesenteric arteries) which supply all the digestive organs: having done so, the viscera may be removed and the other branches of the aorta can then be more satisfactorily exposed. It also appears more natural to connect the description of these arteries which are so closely united in their functions, being distributed to one class of organs and being remarkable for their free communications with each other, from the cardiac orifice of the stomach to the rectum.

In the following description, therefore, I shall consider these three arteries first:

I.

ARTERIA VEL AXIS CŒLIACA.

THIS artery may be exposed by dividing the anterior layer of the lesser omentum near the cardiac orifice of the stomach, and separating some cellular membrane and nerves which cover the aorta.

The cœliac axis arises opposite the lower margin of the last dorsal vertebra, immediately below the aortic opening in the diaphragm, and above the pancreas and vena porta: the lobulus Spigelii is to its right side, the renal capsules and semilunar ganglions are on either side of it; the stomach and lesser omentum are in front of it, and it is enveloped by the solar plexus of nerves, the branches of which accompany those of the artery.

The cœliac axis is about half an inch long, it bends a little downwards and to the left side, and divides into three large branches, which supply the stomach, spleen, and liver, also the duodenum, pancreas, and omentum; the branch which goes to the stomach is the smallest, that to the spleen is the largest, at least in the adult; in the infant the hepatic branch is the largest of the three. The cœliac axis before its division frequently sends small branches to the diaphragm, to the renal capsules, and to the surrounding cellular membrane; one of the proper phrenic arteries often arises from it. The cœliac axis presents great variety in length and size in different subjects, not unfre-

quently it divides into two branches only, in which case that which ought to be its third, will arise from the aorta, or from one of the renal arteries.

I.

ARTERIA GASTRICA VEL CORONARIA VENTRICULI,

Is the smallest of the three branches of the cœliac axis, it often arises from the aorta and sometimes from the splenic artery, it is distributed to the stomach.

The gastric artery runs upwards, forwards and towards the left side, enters the space between the laminæ of the lesser omentum and the lesser curvature of the stomach, and having arrived near the cardiac orifice, it divides into two branches, a superior and an inferior: previous to its division it often gives off the left hepatic artery.

RAMUS SUPERIOR subdivides into several arteries, some of which ascend along the posterior surface of the œsophagus, and inosculate with the arteries which that tube receives from the thoracic aorta; others are distributed to the anterior and posterior walls of the stomach, ramify between its mucous and muscular coats and are directed principally towards the great or splenic end of this organ, where they anastomose with branches of the splenic artery.

RAMUS INFERIOR. This branch is the larger of the two branches into which the gastric artery divides; it appears the continuation of the original trunk; it bends downwards and to the right side, runs

between the laminæ of the lesser omentum towards the pylorus, where it anastomoses with the superior pyloric artery, a branch from the hepatic. The *Ramus inferior* in this course gives off several branches to the stomach and lesser omentum; the latter are small, the former are long and large; they are distributed to each surface of the stomach, and inosculate with the gastro-epiploic arteries which run along its great curvature. The gastric artery frequently sends a branch to the left lobe of the liver, in which case the trunk of this artery is as large as the hepatic artery.*

II.

ARTERIA HEPATICA.

THIS large artery may be exposed by removing the anterior lamina of the lesser omentum, and drawing down the pyloric extremity of the stomach, together with the superior transverse portion of the duodenum, and by raising the liver towards the ribs.

From the cœliac axis the hepatic artery takes a transverse course as far as the pylorus; it then inclines upwards, forwards, and towards the right side, and near the transverse fissure of the liver, terminates by dividing into the right and left hepatic arteries, which supply the two great lobes of this organ. The hepatic artery is surrounded by a plexus of nerves, and

* In the museum of the College of Surgeons, there is a preparation of a large aneurism of this artery close to the stomach.

is enclosed in the lesser omentum and capsule of Glisson, together with the vena porta and biliary ducts; the artery being placed to their left side or nearer the mesial line. Before the hepatic artery divides, it sends off two branches, viz., *arteria pylorica superior*, and *arteria gastro-duodenalis;* it also gives small branches to the pancreas and surrounding cellular membrane.

1. ARTERIA PYLORICA SUPERIOR. This branch arises from the hepatic artery, above and behind the pyloric extremity of the stomach towards which it runs; it gives small branches to it and to the pancreas, and then turns along the lesser curvature and meets the inferior branch of the arteria coronaria ventriculi.

2. ARTERIA GASTRO-DUODENALIS, arises close to the last described branch, sometimes before it; it accompanies the ductus choledochus between the superior portion of the duodenum and the pancreas, and soon divides into two branches, viz., *arteriæ, pancreatica-duodenalis*, and *gastro-epiploica dextra.*

The gastro-duodenalis is a large but short artery; before it divides it gives off two or three small branches, *arteriæ pyloricæ inferiores*, to the inferior part of the pylorus and to the pancreas.

Arteria pancreatica-duodenalis is the smaller of the two branches, it is exposed by raising the ascending layer of the mesocolon from the pancreas, and separating the latter from the duodenum. This artery takes its course between these two organs and gives off branches from either side for their supply;

on the posterior surface of the pancreas one or two long branches may be seen accompanying the duct of this gland, and anastomosing with branches of the splenic artery. The pancreatica-duodenalis artery continues to run in the concavity of the duodenum as far as the root of the mesentery, and it there inosculates with the pancreatic branches of the superior mesenteric artery.

2. *Arteria gastro-epiploica dextra.* This branch runs downwards, forwards and to the left side, enters the space between the laminæ of the great or gastro-colic omentum, and the convex edge of the stomach. The right gastro-epiploic artery is of considerable size, in general it is larger than the short trunk of the gastro-duodenalis, from which it has arisen; it partly supplies the stomach and great omentum, to the latter it gives off several branches, which are remarkably long and tortuous, and which descend to the lowest part of this process; to the stomach also it gives numerous branches, and about the centre of its convex margin it meets the left gastro-epiploic artery, a branch from the splenic.

The gastric and epiploic arteries are situated in a similar manner between the laminæ of the great and little omenta, they are each surrounded by a quantity of loose cellular membrane; when the stomach is empty and contracted, they are about half an inch, and in some places fully an inch distant from that viscus, but in proportion as the latter becomes distended it passes between the folds of which the omenta are composed, and then these arteries which be-

fore were very tortuous become straight, and are brought close to the curvatures of the stomach, each lying in a triangular space the base of which is the stomach and the sides are the laminæ of the omenta. This observation applies to the other arteries which supply the membranous viscera in the abdomen.

The arteries of the stomach and intestines all ramify in a similar manner, between the muscular and mucous coats; if minutely injected, the mucous or villous surface will be found deeply tinged with the colour of the fluid, and will appear as if wholly composed of blood vessels; but the peritoneal or serous coat is not affected even by the most minute injections.

3. *Arteria hepatica sinistra*, opposite the superior angle of the duodenum, and about an inch from the transverse fissure of the liver, the hepatic artery divides into its right and left branches; the left is the smaller of the two, it passes towards the left extremity of the transverse fissure of the liver, in front of the vena porta, and entering the groove which contains the remains of the ductus venosus, it sinks into the substance of the left lobe of the liver, and soon subdivides into ramifications too numerous and too minute to be traced by the knife of the anatomist. The left hepatic artery sometimes arises from the arteria coronaria ventriculi, and sometimes from the trunk of the aorta.

4. *Arteria hepatica dextra* is larger than the last described artery; it passes between the vena porta and hepatic ducts, towards the right extremity of the transverse fissure, and before it enters the liver it sends

off a branch, *arteria cystica*, to the gall bladder; this small artery accompanies the cystic duct to the neck of the gall bladder, where it divides into two branches, one of which ramifies very minutely between the coats of this viscus; the other passes between the gall bladder and the liver, to both of which its branches are distributed.

The right hepatic artery then enters the liver at the right extremity of the transverse fissure, and spreads through its substance in the same manner as the left; both these branches ramify through this organ from the centre towards the circumference, and are each accompanied by a branch of the vena porta and of the biliary duct; branches of these three vessels are always found together in the substance of the liver, and are surrounded by that loose cellular tissue which enters it at the transverse fissure; if a section of the liver be made perpendicularly, that is, from its thick towards its thin edge, the branches of these three vessels will be divided at right angles, and their open mouths may be seen on the cut surfaces, and the vessels themselves will be found retracted into the loose cellular tissue that surrounds them.

The right and left hepatic arteries, before they enter the substance of the liver, send off several small branches, which ramify on its surface; these are not in general filled by a common injection, but if a fine fluid be successfully injected, the whole surface of the liver may be observed to be minutely vascular; the vessels are arranged in a radiated manner, particularly on its convex surface. In a minutely injected sub-

ject also we may observe several anastomoses between the hepatic and other arteries; branches from the phrenic arteries descend from the diaphragm on the liver; branches also from the intercostal and lumbar arteries pass from the abdominal parietes to this organ, and inosculate with the superficial branches of the hepatic arteries. I have frequently too seen branches extending along the suspensory ligament of the liver to the umbilicus, thus connecting the hepatic arteries to the internal mammary and epigastric. These superficial branches of the hepatic artery are well delineated by Ruysch.—*Opera Ruyschii*, epis. v.

ARTERIA SPLENICA.

THE origin of this artery may be seen by separating the cellular membrane and nerves which surround it behind the lesser arch of the stomach, and its termination may be exposed by carefully dissecting between the great end of the stomach and the spleen. A better view of the splenic artery may be obtained by raising the stomach and great omentum towards the thorax, then dissecting the ascending layer of the mesocolon from the pancreas, and drawing down the upper edge of this gland, the whole course of the artery may be seen. The splenic artery may be still more satisfactorily seen by turning down the stomach, having first tied the cardiac orifice and divided the œsophagus.

The splenic artery in general appears larger than the hepatic, it is very tortuous, when injected it ap-

pears remarkably so; its course does not exceed five or six inches in length, although if detached from the subject and extended, it will often exceed twelve inches. The accompanying vein is not so tortuous. It is accompanied by several filaments from the solar plexus of nerves, these run in a straighter manner along the vessel, and thus serve to connect the coils of the latter to one another. I have observed that the coats of this artery are remarkably thin both in its trunk and branches, and in injecting subjects I have found it to burst in old persons more frequently than any other artery in the body.

The course of this artery is first backwards and to the left side, then forwards and downwards; it runs along the superior and posterior margin of the pancreas, accompanied by the splenic vein, which lies inferior to it; the splenic artery passes over the crus of the diaphragm, the semilunar ganglion and the renal capsule of the left side; in this course it gives off several branches—1st, pancreaticæ parvæ; 2nd, pancreatica magna;—3rd, vasa brevia;—4th, arteriæ splenicæ; and 5th, arteria gastro-epiploica sinistra.

1. ARTERIÆ PANCREATICÆ PARVÆ. As the splenic artery runs in the groove in the pancreas, it sends off these branches to supply this gland; they are very numerous, but observe no particular arrangement; they inosculate with the right pancreatic arteries from the pancreatico-duodenalis.

2. ARTERIA PANCREATICA MAGNA arises from the splenic artery near the left extremity of the pancreas, it sinks into the substance of this gland, and

runs from left to right, giving off several small branches to the grains or particles of which this conglomerate gland is composed. This artery is near the posterior surface of the pancreas, and accompanies the duct of this gland towards the duodenum, where it anastomoses with branches of the pancreatico-duodenalis. In many cases I have not been able to see this branch; it is I believe often wanting, its place being supplied by the pancreaticæ parvæ, and by branches from the pancreatico-duodenalis.

3. VASA BREVIA. These vessels, five or six in number, arise from different sources; some arise from the trunk of the splenic artery before it arrives at the spleen; others proceed from the splenic branches, as they are entering the spleen; and in some cases one or two come from the substance of the spleen:—all these arteries pass between the laminæ of the gastro-splenic omentum to the great end of the stomach. Each of the vasa brevia is from two to three inches in length; in this course, they frequently communicate with one another, and having arrived near the stomach, they all divide into several branches, which ramify on the anterior and posterior surfaces of this organ, and anastomose with the gastric artery above, and with the epiploic arteries below, thus completing on the left side the vascular circle which surrounds the stomach.

4. ARTERIÆ SPLENICÆ. As the trunk of the splenic artery approaches the spleen, it sends off five or six branches, some of which are of considerable

size; these vessels enter the spleen along its concave side, some at its fissure, others by the foramina which are placed above and below this fissure: these branches divide in the substance of the spleen in a manner similar to arteries in other glands; it is difficult, however, to trace them for any distance into this organ, their coats become very thin, and the tissue of the spleen is so soft, that it is almost impossible to affirm in what manner they terminate.

5. ARTERIA GASTRO-EPIPLOICA SINISTRA is the last branch of the splenic artery, and appears its continued trunk; it turns forwards, downwards and to the right side, is received between the laminæ of the great omentum and the convex edge of the stomach, and meets the gastro-epiploica dextra, a branch of the hepatic artery.

The left gastro-epiploic artery in this course sends off branches superiorly to the stomach, inferiorly to the great omentum; the former are distributed to the anterior and posterior surfaces of the stomach, and divide into several branches, which unite with those on either side, and form a complete net-work of vessels between the mucous and muscular coats; these branches inosculate with the splenic and gastric arteries. When the stomach is empty and contracted, the left gastro-epiploic artery is near an inch distant from the convex border of its left extremity, but when distended, the vessel is brought into close contact with it. The branches which the epiploic artery gives off inferiorly supply the great omentum; they are very long

and seldom give off any branches of magnitude to either side, but descend undivided vessels even to the lowest part of the omentum; some of the largest then ascend on the posterior surface of this process, and arriving at the arch of the colon anastomose with the colic arteries. These long omental branches are generally surrounded by a line of adeps and are each accompanied by one or two veins; they have very few anastomoses with their corresponding arteries on either side. In cases of old irreducible and strangulated omental hernia, in which the surgeon determines on excising the protruded portion, which is often much altered and diseased, these arteries may each require a fine ligature. As the left gastro-epiploic artery proceeds along the convex border of the stomach giving off the branches that have been just described, it meets the gastro-epiploica dextra; these arteries anastomose not by small branches but the trunks unite, so as to appear like one continued vessel, forming an arch along the convex border of the stomach; this arch of arteries is turned forwards when the stomach is distended, and in thin persons, it is said, can be felt pulsating through the abdominal parietes.—*See Academie des Sciences*, 1715.

Having now traced the three divisions of the cœliac axis to their termination, the student cannot fail to remark the numerous inosculations that exist between the branches of each; the stomach appears the centre of these communications, on it we find several free anastomoses. Around its cardiac orifice, and on its splenic extremity, the arteria coronaria ventriculi and the

vasa brevia unite; along its lesser curvature an arterial arch extends, formed by the inferior branch of the coronary artery, and the pyloric branch of the hepatic; around the pylorus several small arteries anastomose; and the inosculation between the right and left epiploic vessels bounds its convex border.

Of all the membranous viscera in the abdomen, the stomach receives the largest supply of blood; it is completely encircled by arteries from which innumerable branches pass in every direction, communicate with each other, and ramify through all parts of its tissue. When the arteries of the stomach are minutely injected, the mucous or villous coat becomes so deeply tinged with the colour of the fluid, as to appear composed entirely of vessels; the left or splenic extremity appears more vascular than the right. When a portion of a minutely injected stomach is dried the vessels are found arranged in a reticular order, not unlike the manner in which they are distributed in the cutis.

When we contemplate the number and magnitude of the arteries which supply the stomach, and reflect on the functions which this organ performs, we may conclude that the powers of the circulation are exerted in it with considerable energy; how far the circulation is affected by the anastomoses we have just mentioned, presents to the physiologist an interesting subject for inquiry. The arteries of the stomach and intestines are remarkable for their freedom and form of inosculation; in all other situations except at the base of the brain, arteries communicate by small branches

at along the whole course of the membranous viscera f the abdomen, we perceive vessels of considerable ize joining each other and forming arches, the con- exities of which are directed towards the viscera to which they send numerous branches. It is probable these free inosculations may, to a certain degree, exempt these vessels from the influence of the laws of the general circulation, and so tend to establish a peculiar circulation, not merely for the nutrition of these organs, but also for the performance of their different functions. We know that the circulation is carried on with different degrees of energy in different parts and at different times, but how this is regulated or effected remains in obscurity; we know also that the small arteries are possessed of great irritability and probably these anastomoses, almost peculiar to the arteries of the abdominal viscera, lessen or intercept in some way the force of the general circulation, and so favour the organic power of the small vessels exerting itself over their contents. These free anastomoses of the arteries may also admit of the more ready flow or diversion of the fluid they contain from one viscus to another, according as the very elaborate process of digestion may require an increased action in one part, and admit of a state of quiescence in another.

When we consider the magnitude and number of the arteries which supply the abdominal viscera, the manner in which they are spread out and anastomose with each other, and that the arteries are always full of blood, we must conclude that a considerable quan-

ity of this fluid is circulated among the organs in this cavity; we may also infer that the course of the blood through the large arteries must be retarded by these peculiar inoculations, and therefore more powerfully directed to those viscera it is destined to supply.

II.

ARTERIA MESENTERICA SUPERIOR.

THE superior mesenteric artery is one of the largest branches which the abdominal aorta furnishes to the chylopoietic viscera; it supplies the intestinum jejunum and ilium, the cæcum, and all the colon, except its left descending portion.

The superior mesenteric artery and its numerous branches may be exposed without much dissection; raise the transverse colon and mesocolon towards the chest, and secure them in that position, let the mesentery and small intestines fall to the lower part of the abdomen, then dissect off the superior layer of the mesentery from the several glands and vessels which lie between the laminæ of this process; thus the whole course of the mesenteric artery will be seen except its origin, which may be afterwards exposed by dividing a small portion of the root of the mesocolon, and raising the inferior edge of the pancreas.

The superior mesenteric artery arises from the forepart of the aorta about a quarter of an inch below the cœliac axis; as it descends it inclines at first a little towards the left side, lies close to the aorta and is covered by the vena porta and the pancreas; at the inferior edge of this gland it is separated from the aorta by the duodenum and by the left emulgent vein; at the lower edge of the duodenum it is received between the laminæ of the mesentery and then runs in

an oblique direction forwards, downwards and towards the right iliac region, where it terminates by supplying the ilium, cæcum and colon intestines. The superior mesenteric artery is accompanied by two veins and is enveloped in a plexus of nerves derived from the semilunar ganglions and the sympathetic.

The course of the superior mesenteric artery represents an arch whose convexity is directed forwards, downwards and to the left side, from which arise several (fifteen or twenty) arteries to supply the small intestines; the concavity looks upwards, backwards and to the right side; from it three large branches in general proceed.

The superior mesenteric artery in the first part of its course, that is, before it enters the mesentery, gives off three or four branches, which are distributed to the right extremity of the pancreas and to the inferior portion of the duodenum; these branches anastomose with the pancreatico-duodenalis, one of the divisions of the gastro-duodenalis artery which is derived from the trunk of the hepatic.

The three arteries which arise from the concavity of the arch which the mesenteric artery forms, are,—1st, arteria colica media;—2nd, arteria colica dextra;—and 3rd, arteria ileo-colica.

1. Arteria colica media arises from the superior part of the mesenteric artery, while this vessel is covered by the transverse mesocolon, between the laminæ of which process it runs upwards and forwards towards the umbilicus, and about the centre of the mesocolon it divides into two branches, a right and

left; these diverge and each sends off small branches to the colon and anastomoses with corresponding arteries on either side. The left branch inosculates with the arteria colica sinistra which is derived from the inferior mesenteric; this inosculation forms an arch which is convex towards the colon, and from which several branches proceed to supply that intestine. The right branch inosculates in a similar manner with the ascending branch of the colica dextra.

2. ARTERIA COLICA DEXTRA arises from the mesenteric artery, about two inches beyond the last described branch; it also runs between the laminæ of the mesocolon, towards the right ascending colon, and divides into two branches, a superior and inferior; the former inosculates with the right branch of the arteria colica media, the latter with the ascending branch of the ileo-colica; these inosculations also form arches, from the convexity of which proceed many small branches to supply the colon. The arteria colica media and dextra often arise by a common trunk.

3. ARTERIA ILEO-COLICA, is the terminating branch of the superior mesenteric artery, it runs between the laminæ of the mesentery to the right iliac region and divides into three sets of branches, a superior, middle, and inferior. The superior ascends to meet the descending branch of the colica dextra; the inferior descends to meet branches from the mesentery, or from the convex side of the mesenteric artery; and the middle runs to the right iliac region, and near the junction of the ilium and cæcum divides into several branches which communicate with the arte-

ries above and below, forming arches with them, from the convexity of which several large branches arise to supply these two intestines, also the vermiform appendix and the ileo-cæcal and colic valves.

The branches of the ileo-colic artery which supply the cæcum and vermiform process subdivide and often anastomose twice or thrice before they arrive at the intestine.

From the convex side of the mesenteric artery arise fifteen or twenty branches, which supply the jejunum and ilium intestines; they are seen by simply unfolding the different plaits of the mesentery; all these arteries have nearly a similar course and termination; they run nearly parallel between the laminæ of the mesentery, the middle branches are the longest. Soon after their origin they divide into two branches, each of which unites with a similar branch on either side; an arch is thus formed, which is convex towards the intestine; from its convexity arise several branches, which soon divide and communicate with those on either side and thus again form arches similar to the first but smaller; from these arches branches again arise and in some cases communicate a third or even a fourth time. From the last arches arteries run in a straight direction to encircle the intestine, on which they subdivide minutely and form numerous inosculations on their mucous coat, so that when successfully injected this membrane seems wholly composed of vessels.

The branches of the mesenteric artery are equally remarkable with those of the cœliac axis for their free

and numerous inosculations; all the branches which arise from its convex side communicate with each other, and at the cæcum in the right iliac region they unite with the ileo-colic artery, from whence to the left iliac region an anastomosis exists in the mesocolon between the three branches of the superior and the ascending branch of the inferior mesenteric arteries; this latter artery the student should next examine.

III.

ARTERIA MESENTERICA INFERIOR.

THE inferior mesenteric artery is the next branch which the abdominal aorta sends to the chylopoietic viscera; it is an artery of considerable magnitude but smaller than the superior mesenteric: to expose it the student should raise the mesentery and small intestines together with the transverse colon towards the thorax, and divide the peritoneum covering the aorta, the spine and the left kidney.

The inferior mesenteric artery arises from the left side of the aorta, about an inch or less above its division into the common iliacs and an inch and a half or two inches below the origin of the renal arteries. The inferior mesenteric artery runs obliquely downwards and to the left side its course being somewhat curved, the convexity towards the left iliac region; it soon divides into three branches, viz.—1st, the arteria colica sinistra;—2nd, the arteria sigmoidea;—and 3rd, the arteria hœmorrhoidalis superior vel interna.

1. ARTERIA COLICA SINISTRA ascends in front of the left kidney, and divides into an ascending and descending branch; the former inosculates, and forms an arch with the colica media, a branch of the superior mesenteric artery; it also gives several branches to the left lumbar colon. The descending branch unites in a similar manner with the sigmoid artery.

2. ARTERIA SIGMOIDEA runs transversely, it

crosses the psoas muscle to the sigmoid flexure of the colon, and divides into several large branches, which supply this portion of the intestine, and anastomose with the last described artery; this artery also sends some small branches to the ureter, and to the psoas and iliacus internus muscles. The inferior mesenteric artery often gives off two or three distinct branches to this part of the intestine.

3. ARTERIA HÆMORRHOIDALIS SUPERIOR, is the largest branch of the inferior mesenteric artery; it runs towards the left ilio-sacral articulation, crosses the ureter and the left iliac artery and vein, is received between the laminæ of the mesorectum, and descends into the pelvis, along the posterior part of the rectum, which intestine it supplies with numerous branches. Opposite the middle of the sacrum, the hæmorrhoidal artery divides into two large branches, which descend along the sides of the rectum; these subdivide into several small branches, which anastomose with each other and with the middle hæmorrhoidal arteries on each side, which are branches from the internal iliac. Some long branches of the superior hæmorrhoidal artery descend as low as the anus, and there anastomose with the external hæmorrhoidal, which are branches from the internal pudic.

The superior hæmorrhoidal artery is accompanied by some nerves, and by several large tortuous veins. The hæmorrhoidal artery and its branches deserve the attention of the surgical anatomist, as they are concerned in the operation for fistula in ano; the student may observe that this vessel descends on the back

part of the rectum, to within one finger's length, or about four inches of the anus, before it divides; this will apprise him of the danger of dividing the rectum to that height, in case the disease extends in that direction.

The lower part of the rectum is extremely vascular, the surrounding cellular membrane containing numerous veins and arteries; in cases of long continued disease these vessels become much enlarged, and when divided in operations for the cure of hæmorrhoids or of fistula, or for the removal of excrescences of the mucous membrane, which sometimes protrude at the anus, they bleed so profusely as frequently to endanger the life of the patient; the hæmorrhage is not in general alarming at the time of the operation, but in some hours after we may find the patient reduced to a state of great weakness, although little or no blood is seen; however, it flows freely into the intestine, and the contraction of the sphincter or the compresses at the wound prevent its escape externally; the rectum becomes distended, and the patient cold and weak, he feels great irritation about the neck of the bladder, and tenesmus, and on going to stool he discharges a quantity of blood, partly fluid, partly coagulated; this in some cases is followed by syncope, which may assist in putting a stop to further hæmorrhage. Should, however, the bleeding recur, the surgeon must open the wound, and having introduced a large piece of sponge, with a ligature attached to it, into the rectum, higher than the divided vessel, so as to prevent the blood from ascending into the intestine,

he should then apply dossils of lint to the bottom of the wound, and retain these by a well regulated graduated compression, or by the hand of a careful assistant.

The student can again examine the superior hæmorrhoidal artery when dissecting the vessels in the pelvis.

The superior and inferior mesenteric arteries communicate so freely along the left descending colon, that if the abdominal aorta be tied between the origin of these two arteries, and the subject injected from the heart, the fluid will pass through this mesenteric inosculation to the lower part of the aorta, and so to the inferior extremities.

The branches of the mesenteric arteries are remarkable not only for the freedom, but also for the form of their inosculations. The branches of the superior mesenteric artery which supply the small intestines, communicate with each other more frequently than those which go to the colon, or than those of the inferior mesenteric; the anastomoses of the former present a reticulated appearance in the mesentery, the branches enclosing spaces of different area and figure; the branches which supply the large intestine seldom anastomose with each other more than once or twice between their origin and termination. From these anastomoses, both of the superior and inferior mesenteric arteries, branches proceed in a straight direction to the concavity of the intestine, and pass some on its anterior, others on its posterior surface; according as the intestine is empty or distended, it appears at a

greater or less distance from the origin of these arteries. When these straight branches have arrived at the intestine they divide very minutely, and form a complete network of vessels between the mucous and muscular coats; his network is well seen in a minutely injected intestine which has been dried, and then suspended in oil of turpentine.

The small intestines receive their supply of blood from their concave side only, whereas the stomach receives its arteries both from its concave and convex borders, but particularly from the latter; the arteries which supply this organ have but one inosculation with each other before their branches become reticulated in its coats, but the arteries of the small intestines form a remarkable network in the mesentery, which is connected by straight branches to that which is in their parietes.

The vessels which are distributed to the colon, are not so numerous as those of the stomach and small intestines, and when all the arteries of the alimentary canal have been minutely injected, a striking difference appears in the degree of vascularity in the mucous membrane of the large and small intestines: the large intestines are also supplied principally from their concave edge; a few arteries, however, from the omentum and abdominal parietes occasionally pass to the convex border of the colon and cæcum; the arteries which supply the large intestine are not so reticulated either before they arrive at the intestine, or even at their termination on its parietes.

If we encourage the idea of the functions of ves-

sels being at all depending on or affected by their previous anastomoses, we may form some conjecture as to the cause of those differences which exist in the anastomoses of the arteries which supply the stomach, the small and the large intestines.

The student may now proceed to examine the other branches which the abdominal aorta sends off; namely, the phrenic, capsular, renal, spermatic, lumbar, and middle sacral arteries: to expose these, he should remove the stomach and intestines, having first tied the œsophagus and rectum, and having divided the gastric, splenic, and mesenteric arteries, also the biliary ducts, leaving the liver, kidneys, and vena cava, in their situation; a better view of the aorta will be now obtained, and of the manner in which it is pushed forwards by the convexity of the lumbar vertebræ, also of the opening between the crura of the diaphragm, through which this artery enters the abdomen.

ARTERIÆ PHRENICÆ.

The phrenic arteries are two in number, they are the first branches of the abdominal aorta, and arise from its anterior part immediately above the cœliac axis; each artery passes upwards, outwards, and forwards to the diaphragm, to which it is distributed. The phrenic artery of the left side passes behind the œsophagus, that of the right side behind the liver and vena cava. At the posterior edge of the cordiform tendon each artery divides into two branches, an external and internal; the former supplies the fleshy fibres of the diaphragm on each side, and divides into numerous branches, which run towards the ribs, and inosculate with the intercostal arteries. The internal branch of each phrenic artery is directed forwards round the cordiform tendon, distributes its branches in every direction; behind the xyphoid cartilage it anastomoses with its fellow, and with the internal mammary arteries. The internal branch of the phrenic artery of the right side sends some small branches to the vena cava, which anastomose with the superior phrenic artery, a branch of the internal mammary; on the left side this branch sends small arteries to the œsophagus, which in like manner communicate with the superior phrenic, and with the œsophageal branches of the thoracic aorta. The phrenic arteries in the first part of their course give off several small branches to the crura of the diaphragm, to the pancreas, to the semilunar ganglions, and to the cellular membrane which

surrounds them, also to the renal capsules, along the superior edge of which each artery runs; the spleen also on the left side, and the liver on the right, sometimes receive small branches from these vessels.

The phrenic arteries are of uncertain origin, they often arise by a common trunk; sometimes one or both arise from the cœliac axis, or from one of its branches, and not unfrequently the right phrenic artery is found to arise from the renal.

On the diaphragm we find several inosculations between the arteries of the neck, thorax, and abdomen. A muscle of such importance in the animal economy as the diaphragm must receive a great quantity of blood; the phrenic arteries are not the only source from which it is supplied, the phrenic nerve of each side has its accompanying artery, which is derived from the internal mammary, these branches are distributed to the centre of this muscle; the six inferior intercostal arteries, and the internal mammary, send branches to its fleshy circumference, and the two or three superior lumbar arteries in like manner supply its crura and the posterior part of each ala.

ARTERIÆ CAPSULARES VEL ATRABILIARIÆ.

The arteries which supply the renal capsules are very small in the adult, but in the fœtus they are as large as the renal arteries; they are very irregular in their origin. These bodies in general receive their blood from three sources, namely, from the phrenic above, from the aorta in the centre, and from the renal below.

The proper capsular arteries arise on each side of the aorta, opposite the mesenteric artery; they pass obliquely upwards and outwards, and are distributed to the renal capsules and to the surrounding cellular membrane; they also send branches to the psoas muscle and to the different viscera in their vicinity.

ARTERIÆ RENALES VEL EMULGENTES.

The renal or emulgent arteries arise between the two mesenteric arteries, they are the largest branches of the abdominal aorta, with which they form an angle a little less than a right one. The two renal arteries are nearly of the same size, the left is shorter than the right, and covers its accompanying vein; the right renal artery in general arises lower down than the left, it passes behind the vena cava, and is covered by its corresponding vein; the relation which these arteries and veins bear to each other is very irregular. Each renal artery passes obliquely downwards, backwards, and outwards, towards the kidney, and in this course

gives off small branches to the renal capsule, to the ureter, and to the surrounding cellular membrane and muscles. At the pelvis of the kidney each artery generally, but not constantly, lies between the vein and ureter, the former in front of, the latter behind the artery. The renal arteries then divide into four or five branches, which pass into the substance of the kidney as far as the papillæ; around these each artery divides into several minute branches, which pass between the tubuli uriniferi, as far as the inner edge of the cortical substance, where they unite with one another, forming arches, the concavity of which is directed towards the tubuli, which are thus separated from the cortex; from the convexity of these arches proceed numerous branches, which ramify through the cortical substance, some extend even to the capsule of the kidney, and ramify upon it.

If the kidney be minutely injected and corroded, the cortex is found to consist almost wholly of arteries and veins; these vessels communicate very freely with each other, and with the branches of the ureter, as is proved by injection. When the branches of the renal arteries have penetrated the kidney, they twine around the veins and the branches of the ureter. We frequently find two or three, or even more, renal arteries on one or both sides, sometimes one of these will pierce each extremity of the kidney, and the others will enter at its pelvis. When the renal arteries thus arise in separate branches, the superior is often derived from the mesenteric, and the inferior from the

common iliac artery; the renal veins are more regular in their number than the arteries.

The chief glandular viscera of the abdomen, as the liver, spleen, and kidneys, are each supplied in somewhat a similar way; a large artery sinks into their substance, and divides into numerous branches, which ramify through all parts of their structure; the kidneys, in particular, are remarkable for the size of the arteries which supply them; these vessels too are very short, so that the circulation in these glands may, as Bichat observes, receive a more lively impression or impulse from the general system, which may in some degree account for the rapidity of the urinary secretion.

ARTERIÆ SPERMATICÆ.

These two arteries arise immediately below the renal from the fore part of the aorta, at a very acute angle; they pursue a very tortuous course downwards and outwards, accompanied by one or two veins, and by several small nerves, which descend from the renal plexus and from the sympathetic nerve. Each spermatic artery passes obliquely across the psoas muscle and the ureter, and descends on the external side of this vessel; the right spermatic artery crosses the vena cava also. The spermatic arteries in the male subject incline more outwardly in their descent than in the female, and arriving at the internal abdominal ring, each joins the vas deferens, and descends, forming a part of the spermatic cord, to the testicle.

The right spermatic artery often arises from the

right renal; sometimes there are two spermatic arteries on one side, and but one on the opposite.

While the spermatic artery lies in the abdomen, it gives off several small branches to the psoas muscle, to the ureter, and surrounding cellular membrane; in the inguinal canal it gives off small branches to supply the muscles, which anastomose with the epigastric and with the superficial branches of the femoral. The spermatic artery in some subjects is found larger at its lower than at its upper extremity. As the artery approaches the testicle, it divides into six or seven branches, two or three of these accompany the vas deferens and are distributed to the epidydimis; the other branches pass forwards, pierce the tunica albuginea at its posterior part, and enter the substance of the testicle; here they again subdivide into numerous branches, which inosculate with each other and form beautiful arches, many of which can be discerned through the tunica albuginea as they run between it and the tubuli testis; others pass along the septa of this gland, and communicate with the tubuli seminiferi. Beneath the tunica albuginea or the fibrous coat of the testicle, the blood vessels are arranged in considerable number, so as form a soft, vascular surface or membrane analogous to the pia mater, from which several straight vessels extend along the septum of the testicle.

In the female the spermatic arteries arise in the same situation as in the male, and pursue nearly a similar, but in general a more tortuous course, as far as the pelvis, but then each artery bends inwards, and

is received between the laminæ of the broad ligament of the uterus, which conducts it to the ovarium. The spermatic artery then divides into several branches, some ramify on the posterior surface of the ovary, and in very minute injections will be found to enter its substance, other branches descend along the Fallopian tubes to the uterus, in the structure of which they anastomose with the proper uterine arteries from the internal iliac. One or two small branches of each spermatic artery are reflected outwards along the round ligament of the uterus, and passing through the inguinal canal, are distributed to the muscles and integuments in the groin, where they anastomose with the superficial branches of the femoral.

During the first six months of fœtal life, the spermatic arteries are short, as the testes then lie by the side of the spine, below the kidneys. The spermatic arteries in the first part of their course are straight, but as they approach the testes or ovaria, they become extremely tortuous; it has been rightly observed by Mr. C. Bell, that those organs of the human body, which have an occasional remission of their activity, or which have an occasional call for an increase of their functions, are remarkable for the tortuous form of their arteries; the vessels of the uterus, testicle and spleen, are good examples of this fact.*

In the operation of castration, the contraction of the cremaster muscle and the retraction of the spermatic artery within the cellular membrane of the

* See Essay on the Circulation of the Blood.

cord, have been found to produce some difficulty in the application of the ligature to the divided artery; to obviate this, it has been proposed to include in a ligature the entire cord before dividing it, and the cord being cut across, to tie the spermatic artery separately before the general ligature is removed. This proceeding, however, adds considerably to the pain of the operation, which may be avoided and the object effected by the operator taking hold of the cord with his left hand, and having divided it, by drawing out the artery with the tenaculum or forceps so that an assistant may secure it in a ligature. While the surgeon still holds the cord, he should examine if it be necessary to tie more than one artery, as in cases of long continued disease the branches of the spermatic and epigastric often become enlarged.

Between the origin of the spermatic arteries and of the inferior mesenteric, the aorta generally gives off some small branches to the ureter, to the fat which surrounds the kidney, and to the cellular membrane, and lymphatic glands which lie along the lumbar vertebræ; these branches are described by some writers under the name of the *adipose* and *ureteric arteries;* they, however, are in general so irregular and uncertain, that I have not considered it necessary to direct the attention of the student particularly to them.

Although the coats of the ureter do not appear very vascular, yet they receive arteries from several sources, namely, from the aorta, the renal, spermatic, lumbar, iliac, and hypogastric arteries. These different branches also supply the surrounding cellular membrane and muscles.

The adeps around the kidney also receives arteries from different sources, from the phrenic, capsular, renal, and spermatic, and occasionally from the aorta; these branches anastomose on the kidney with the arteries of that gland, and on the surrounding muscles with the lumbar arteries.

Numerous small arteries may be seen ramifying on the aorta itself; some of these arise from the different arteries in the vicinity; others arise from the parent trunk, twine around it in a serpentine course, distributing their branches to its coats, and anastomosing with each other. In no part of the arterial system are these small vessels (which are commonly called he *vasa vasorum*) more distinct and numerous than around the abdominal aorta; in a young subject, minutely injected, they render the external coat of this vessel and the surrounding cellular membrane so vascular, as to give to its sheath the appearance of an highly organized membrane, in which also may be traced innumerable filaments of nerves derived from the sympathetic, and its different ganglia; this tissue, so abundantly supplied with nerves and vessels, is not confined to the aorta, but may be seen on its different branches, and particularly on those which supply the chylopoietic viscera.

ARTERIÆ LUMBALES.

THE lumbar arteries arise from the posterior part of the aorta, nearly at right angles, opposite the intervertebral ligaments; they are generally five in number on each side; the fifth or last sometimes arises from the common iliac arteries; the lumbar arteries of opposite sides occasionally arise in common and sometimes two or even three of the same side arise together. The lumbar arteries are all nearly alike in their course and termination, and resemble very much the intercostal arteries; the superior pass transversely, the inferior descend a little; they run from their origin outwards and backwards along the sides of the vertebræ, behind the sympathetic nerve the crus of the diaphragm and the psoas muscle both which muscles they supply.

When each lumbar artery has arrived opposite the space between the transverse processes of the vertebræ, it gives off three sets of branches; the first are the spinal, which are two in number, and of considerable size; these branches are conducted along the lumbar nerves through the intervertebral foramina into the spinal canal, one branch is then distributed to the spinal marrow and its membranes: the other runs on the posterior part of the body of the vertebra, meets the corresponding artery from the opposite side, and both send several branches into the substance of the bone and into the intervertebral ligaments; the princi-

pal branches enter the bone through a large hole that may be seen on the back of the body of each lumbar vertebra.

The second set of branches of the lumbar artery are the posterior muscular branches; these pass backwards between the transverse processes of the lumbar vertebræ to supply the lumbar mass of muscles, some are very long and large, and anastomose with each other and with the posterior branches of the intercostal arteries.

The third set are the external; this, which is generally single, is the largest, and appears to be the continuation of the original trunk; it is by no means, however, so large as the corresponding branch of each intercostal artery. The external or abdominal branch of each lumbar artery passes outwards between the psoas and quadratus lumborum muscles, giving small branches to each, also to the diaphragm, kidney, renal capsule and the surrounding cellular membrane, and then divides into several long branches which run between the laminæ of the abdominal muscles, accompanied by branches of the lumbar nerves; these arteries anastomose with the intercostals above, with the ilio-lumbar and circumflex ilii below, and with the epigastric and internal mammary in front.

ARTERIA SACRA MEDIA.

This is the last branch of the abdominal aorta; it arises from its posterior part a little above its division; it sometimes comes from one of the iliacs (the right) or from the last lumbar artery.

The middle sacral artery is almost as large as one of the lumbar arteries, it descends nearly in the direction of the middle line of the sacrum, and close to this bone as far as the coccyx, where it divides into branches which bend to either side and form an arch with the lateral sacral arteries. The middle sacral artery gives off branches to the rectum, to the sacrum, and to the muscles which are attached to it, it also sends off transverse branches at each division of the sacrum, which supply this bone, and anastomose with the lateral sacral and hæmorrhoidal arteries.

I think I have observed this artery to be larger in the fœtus in proportion, than in the adult. In animals it may be named the "caudal artery," and is always of a proportionate magnitude to that of the tail; where this appendix is large, as the prehensile tail of some monkeys, or as in the kangaroo, this artery will be found of considerable size. In fish this artery appears as the termination of the aorta. In tailless animals it will be absent.

ARTERIÆ ILIACÆ COMMUNES.

On the body of the fourth lumbar vertebra, or on the ligament between that and the fifth, the abdominal aorta usually divides into the two iliac arteries; the point of its division is nearly opposite the left margin of the umbilicus; great variety, however, is observed in this respect, it sometimes divides so high as the third and sometimes so low as the fifth lumbar vertebra.

The right and left common iliac arteries are of equal size; they diverge, each inclining downwards and outwards, and opposite the ilio-sacral symphysis they divide into two large branches, named the external and internal iliac arteries; the former supplies the lower extremity with blood; the latter supplies the viscera and the parietes of the pelvis.

The common iliac arteries form an acute angle with each other, this angle is observed to be more open in the female than in the male: these large arteries are covered by the peritoneum: the division of each is crossed anteriorly by the ureter; the psoæ muscles are situated on the external side of them; the commencement of the rectum is anterior to the artery of the left side, and the termination of the ilium, the left side of the cæcum, and the vermiform appendix are connected to that of the right. The common iliac artery of the right side is somewhat longer than that of the left, and takes a more oblique course across the last lumbar

vertebra, it also passes over the left common iliac vein and the commencement of the vena cava; the common iliac artery of the left side descends more in the direction of the aorta, and lies external and anterior to its accompanying vein. These arteries seldom give off any branch of magnitude; they both give small branches to the peritoneum, to the psoæ muscles, to the ureters, and to the surrounding cellular membrane: occasionally the right one gives off the middle sacral, and the left the last of the lumbar arteries. In young subjects these arteries are generally very straight, but in old subjects I have frequently found them extremely tortuous, particularly that on the right side.

The student may now proceed with the dissection of the internal and external iliac arteries. It is a matter of no importance to which the student shall first direct his attention. We shall first describe the internal iliac artery.

ARTERIA ILIACA INTERNA VEL HYPOGASTRICA, VEL UMBILICALIS.

THE student should examine this artery in the fœtus, as well as in the subject of maturer age. The internal iliac artery presents a striking difference in its magnitude, course, and termination, in the child before or at birth, and at some time subsequent to that period. This artery in the fœtus usually receives the name of umbilical or hypogastric; in after life it is commonly called internal iliac: if examined in the fœtus it will be found twice as large as the external iliac, and will appear as the continuation of the common iliac artery; whereas, in the adult, the external iliac exceeds the internal nearly in the same proportion, and appears not only in size but also in direction, as the continued trunk of the primitive iliac.

We may first briefly consider the course and termination of the umbilical or hypogastric arteries in the fœtus; at this age these arteries proceed from the division of each common iliac artery, or from the ilio-sacral symphisis, downwards and forwards to the bladder, forming in this part of their course an arch, the convexity of which is directed downwards, and from which arise several small branches. Each hypogastric artery then ascends along the side of the bladder to its superior fundus, and thence runs on either side of the urachus, between the peritoneum and recti muscles, to the umbilicus. Having passed through

this opening, these arteries become a part of the umbilical cord, and twine around the umbilical vein; in this part of their course they appear smaller than while they were in the abdomen; when they have arrived near the placenta they sometimes inosculate with each other, and then branch out into numerous ramifications through all parts of this spongy vascular substance. In utero these arteries serve the offices of veins, and are the only media by which the blood can be returned from the fœtal to the maternal circulation. After birth when the umbilical vessels are tied a coagulum of blood fills each of these arteries, and extends from the umbilicus to the side of the bladder; these vessels then gradually contract, the coagulum becomes absorbed and in a very few years after birth, nothing but a ligamentous substance marks the former course and situation of these arteries between the bladder and the umbilicus. While this change is being effected, not only is the external iliac artery increasing in size, but also those branches which arise from the back part of the internal iliac. If examined at a still more advanced period of life, this obliteration of the artery is found to have extended still farther back, so that from the sciatic notch to the bladder a very small branch, or sometimes only a ligamentous substance exists.

The student may now proceed to examine the internal iliac artery in the adult subject. The trunk of this artery may be exposed without much dissection; raise the fold of the peritoneum which extends from the rectum to the bladder, by detaching it from the

iliac fossa towards the pelvis, and avoid injuring the ureter, vas deferens or internal iliac vein. The internal iliac artery separates from the primitive iliac opposite the ilio-sacral symphisis, and is generally higher on the right side than on the left, it is a large but short trunk, seldom more than an inch and a half or two inches long before it gives off its branches: from its origin it runs tortuously downwards and backwards, converging a little inwards in front of the ilio-sacral symphisis, as far as the upper part of the sciatic notch, where it divides in general into two, and sometimes into three branches; from the point of division, however, a small artery continues forwards to the bladder, and ends in a ligamentous substance, which ascends on the side of this organ to its apex, and thence proceeds along the abdominal muscles to the umbilicus, thus marking the course and situation of the former umbilical artery.

Each iliac artery in this course, that is from its origin to the sciatic notch was covered by peritonæum, and is accompanied by the internal iliac vein, which lies posterior to it; on the right side the vein is also to the external side of the artery; the origin of the pyriformis muscle, and the sacral nerves, as they escape from the anterior sacral foramina are internal, and the communicating branch of the lumbar plexus is posterior to each; the obturator nerve is to the outer side, the ureter crosses at the commencement, and the vas deferens at the ligamentous termination of each. If the student have an opportunity of contrasting the course of this artery in the adult and in the fœtus, he

will find considerable difference to exist in it at these different periods of life. In the adult, the artery passes backwards and downwards deep into the pelvis to the sciatic notch, where it appears to terminate, as its principal branches pass through this opening. The convexity of the arch which the artery forms, looks backwards and upwards towards the ilio-sacral symphysis, from which it is only separated by a vein and nerve; whereas in the fœtus this artery (which is much larger in proportion than in the adult) passes forwards and a little downwards and then upwards; and the convexity of the arch which is thus formed looks downwards and outwards. At this age, this artery can scarcely be considered as contained in the pelvis, but runs nearly parallel to the superior border of this cavity; the branches which it gives off are very small, and the trunk of the artery does not appear diminished in size after their origin.

The trunk of the internal iliac artery is but seldom found diseased, some of its branches, however, may become the seat of aneurism from disease or accident; in such cases, if the branch directly connected with the disease cannot become the subject of operation, it has been suggested, that applying a ligature on the trunk of the internal iliac artery may be attended with good effects; this operation has been performed in two cases of gluteal aneurism, and in one of them with perfect success.* These cases have established the

* See account of a case of gluteal aneurism, *Medico-Chirur. Trans.* vol. v. p. 422; *Med. and Phys. Jour.*, vol. xxxviii. p. 267, also *Guthrie on Injuries of the Arteries.*

iliac fossa towards the pelvis, and facility, ureter, vas deferens or internal med, that nal iliac artery separates fr es of the posite the ilio-sacral symp subject a liga on the right side than his vessel, yet in short trunk, seldom r ust be attended with or two inches long n will be great in proport from its origin it d fatness of the individual; backwards, conv great danger of being injured, an the ilio-sacral at in old subjects I have often fou of the sciatic and easily torn in this situation, so th into two, an to detach it from the artery in practisin the point o on the dead body, I have sometimes lace forwards membrane. The ureter in some subjects substanc ely connected to this artery; the internal iliac its ape also intimately attached to it, and the mobility of muscl vessels adds to the difficulty of separating them situn each other, for the operator can only venture to E the fingers of one hand, and no sharp instrument gin with safety be employed, on account of the prox- and ity not only of the internal iliac vein, but also of li e external iliac artery and its vein. In the dead to ubject I have experienced less difficulty in tying the p common iliac, than the internal iliac artery; indeed, I feel disposed to prefer the former operation even dur- ing life: although the direct supply of blood to the leg and thigh should be thus cut off, yet great reliance may be placed on the lumbar and pelvic inosculations.

The operation of tying the internal iliac artery may be performed in the following manner: place the pa- tient on his back, and bend the lower extremities on

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practicability of this operation; as to the facility, however, with which it may be performed, that will greatly depend on the circumstances of the case. Although in the dead emaciated subject a ligature may be easily passed around this vessel, yet in the living subject the attempt must be attended with considerable difficulty, which will be great in proportion to the muscularity and fatness of the individual; the peritoneum is in great danger of being injured, and I may remark, that in old subjects I have often found it very thin, and easily torn in this situation, so that in attempting to detach it from the artery in practising this operation on the dead body, I have sometimes lacerated this membrane. The ureter in some subjects is very closely connected to this artery; the internal iliac vein is also intimately attached to it, and the mobility of these vessels adds to the difficulty of separating them from each other, for the operator can only venture to use the fingers of one hand, and no sharp instrument can with safety be employed, on account of the proximity not only of the internal iliac vein, but also of the external iliac artery and its vein. In the dead subject I have experienced less difficulty in tying the common iliac, than the internal iliac artery; indeed, I feel disposed to prefer the former operation even during life: although the direct supply of blood to the leg and thigh should be thus cut off, yet great reliance may be placed on the lumbar and pelvic inosculations.

The operation of tying the internal iliac artery may be performed in the following manner: place the patient on his back, and bend the lower extremities on

the trunk, so as to relax the abdominal muscles; an incision three or four or even five inches long is to be made through the integuments of the lower part of the abdomen parallel to the epigastric artery, that is, in a line drawn from the centre of Poupart's ligament towards the umbilicus. The inferior extremity of this incision may terminate about an inch above Poupart's ligament, so as not to endanger the spermatic chord, and the superior extremity may end at the outer edge of the rectus muscle. The three laminæ of the abdominal muscles are next to be cautiously divided on a director to the same extent; the fascia transversalis may be then torn through with the finger, and the peritoneum can be easily detached from the iliac fossa towards the pelvis: this part of the operation will be facilitated if the patient's bowels have been previously emptied by a smart cathartic. If the finger be now passed to the inner side of the cavity which has been thus formed, the pulsation of the external iliac artery will be felt, and by following this to its origin, or towards the spine, the internal iliac will be discovered lying internal and rather posterior to it, the chord-like feel of the obturator nerve may also assist in guiding the finger to the vessel. The origin of the internal iliac will be found nearly opposite the centre of a line drawn from the anterior superior spinous process of the ilium to the umbilicus. Then with the nail of the index finger, or with the eye of a bent probe, this artery may be separated from its accompanying vein which lies behind, and on the right side a little external to it. The sides of the wound

should now be held asunder by two broad spatulæ, slightly curved, and the aneurism needle can be carried around the internal iliac artery, directing it from within outwards, or towards the psoas muscle, taking care to avoid the ureter and peritoneum internally, and the external iliac vessels externally. If an assistant press these vessels outwards and backwards towards the iliac fossa, they will be more effectually protected, and this part of the operation will be facilitated: the ligature should be applied low down on the trunk, as far from the bifurcation of the common iliac as possible.

A ligature may be passed round the common iliac artery by an operation similar to that now described; this I have frequently practised on the dead subject, and have experienced very little difficulty in effecting it. In a very thin subject a ligature may be passed round the aorta, between the origin of the inferior mesenteric artery and its division into the iliac arteries, without injuring or opening the peritoneum, by making the incisions through the integuments and abdominal parietes in the same direction, and to a little greater extent superiorly than in the operation of tying the internal iliac artery. In the operation of tying the aorta or the common iliac artery, it may be advisable always to make the external incision longer.* The application of a ligature to the common iliac artery is in the dead subject very practicable, and I should think it must be a very rare occurrence indeed in which this operation may not answer all the pur-

* See account of a case in which the common iliac was tied by Mr. Crampton, *Med. Chir. Trans.* vol. xvi. Part 1. p. 157.

poses of a ligature on the aorta itself; indeed, I can scarcely conceive a case in which the latter will be necessary, except in the event of wound of the common iliac, or secondary hæmorrhage after the operation just now described.

The principal branches of the internal iliac artery are nine in number; these may be divided into two sets, an internal, which supply the parts within the pelvis, and an external, which supply the parts external to this cavity. The internal set consist, in the male, of five, namely, the *ileo lumbar, middle hæmorrhoidal, lateral sacral, vesical and umbilical;* in the female two more may be added, viz., the *uterine* and the *vaginal.* The external set are four in number, namely, the *obturator, gluteal, sciatic, and pudic;* these are principally distributed to the great muscles which lie external to the pelvis, and are considerably larger than the internal branches.

All these branches are almost always to be found, but as to their origin, they are very uncertain; sometimes the internal iliac artery will give off but two branches, and from these all the others will be derived; and the obturator is found to arise nearly as often from the epigastric artery as from the internal iliac.

The student will find it more convenient to trace these branches according to this arrangement than by classing them into anterior, posterior, internal, and external.

There are few vessels in the body the dissection of which is more troublesome or complicated than that of the internal iliac artery and its branches; it is one,

however, to which the student should devote considerable time and attention, as many important practical inferences may be deduced from a correct knowledge of the relative anatomy of this artery and of its numerous ramifications.

The student may first examine the internal set of branches; to expose these, empty the bladder and rectum, detach the peritoneum from the side of the pelvis, and carefully remove a quantity of loose cellular membrane which lies beneath it, and which contains numerous veins; all the internal branches of this artery may be then exposed by a little dissection without dividing the pelvis. A more satisfactory view, however, of these arteries may be obtained when a section of this cavity has been made; but this can be done with greater advantage at a future stage of he dissection, when some of the external set of branches, particularly those in the perinæum, have been examined.

I.

ARTERIA ILIO-LUMBALIS,

Arises from the external and posterior part of the internal iliac artery, and runs obliquely upwards, backwards, and outwards, to the iliac fossa, where it divides into three sets of branches. In this course the ilio-lumbar artery lies anterior to the ilio-sacral symphysis and to the communicating branch of the last lumbar nerve, and passes behind the external iliac artery and vein, the anterior crural nerve, and the

psoas and iliac muscles; in this part of its course it gives off several small branches which ramify through the substance of these muscles. At the upper and internal part of the iliac fossa, the ilio-lumbar artery divides into several branches, some of which ascend, others descend, and the third pass outwardly.

The ascending branches supply the psoas and quadratus lumborum muscles, anastomose with the lumbar arteries, and with branches from the renal and spermatic; branches also accompany the lumbar nerves into the spinal canal.

The descending branches of the ilio-lumbar artery ramify through the substance of the iliacus internus muscle, some run between it and the bone; a considerable branch may be seen passing into the diploe of the latter by an oblique canal which commences about the centre of the iliac fossa; other branches descend on the surface of the psoas and iliac muscles to the groin, and anastomose with branches of the epigastric and femoral arteries.

The external set of branches of the ilio-lumbar artery are the principal, they pass across the iliac fossa, giving off several arteries to the iliac muscle; some small branches then turn over the crest of the ilium, enter the glutæi muscles, and communicate with branches of the gluteal artery; others run along the inner edge of the crest of the ilium, towards the anterior spinous process of this bone to meet branches of the arteria interna circumflexa ilii, which is derived from the external iliac; small branches also from the ilio-lumbar artery anastomose on the fore part of the

inwards beneath the peritoneum along the anterior and lateral part of the rectum, and divides into several branches, some of which ascend and inosculate with the superior hæmorrhoidal artery, others descend and communicate with branches of the pudic artery; the hæmorrhoidal artery also sends branches to the fore part of the rectum, some of which are distributed to the bladder, vesiculæ seminales, to the prostate gland in the male, and to the inferior surface of the uterus and vagina in the female. This artery is said to be larger and more regular in the female than in the male. Its place is often supplied by two or three arteries instead of a single vessel.

IV.

ARTERIÆ VESICALES,

Are generally three or four in number; they are very irregular as to their origin, being found to arise indifferently from the sciatic, pudic or hæmorrhoidal or from the trunk of the internal iliac; their branches are principally distributed to the inferior fundus of the bladder; but few arteries are observed on the superior part of this organ.

The vesical arteries may be divided into three sets, the inferior, middle, and superior. The first are derived from the hæmorrhoidal, pudic and sciatic; the superior are given off from the umbilical branch; and the middle vesical artery in general arises from the internal iliac, near its ligamentous termination, but

very frequently from some of its branches. The middle vesical artery usually accompanies the ureter to the bladder, and there divides into numerous branches, which ramify between the coats of this viscus in all directions, and anastomose with the other arteries which supply this organ, and with corresponding branches from the opposite side. The inferior vesical artery, or the branches corresponding to it are larger and more numerous, at least in the adult and old person, than either the middle or superior vesical arteries; hence the neck and inferior fundus or region of this viscus are more vascular than any other regions. In the course of this dissection of the inferior vesical arteries, the student cannot fail to observe the great number of veins in this region; these veins come from different sources, some from the perinæum, some from the penis, others from the prostate and vesiculæ seminales, in the vicinity of the latter they form plexuses with which the veins of the rectum and surrounding fat communicate; these veins are very large and numerous in the adult, they all communicate directly or indirectly with the internal iliac veins.

V.

ARTERIA UMBILICALIS.

This in the fœtus is the continuation of the internal iliac artery, and appears to have given off all the pelvic branches; it bends upwards, forwards and inwards along the side of the bladder, and then ascends behind

the abdominal muscles to the umbilicus, enclosed in a fold of peritonæum which connects it to the urachus, and to the opposite artery. In the adult, however, it is very small, although its coats are thick: it is seldom pervious beyond the side of the bladder, and there it ends in a ligamentous substance; this artery gives off several branches to the bladder, which principally ramify on the side and posterior part of this organ; these branches anastomose with the other vesical arteries, and with the corresponding branches from the opposite side.

VI.

ARTERIA UTERINA.

This artery arises from the internal iliac after the middle hæmorrhoidal; it very frequently arises from the pudic; the uterine artery, though small, is remarkably tortuous, it passes forwards and inwards, runs between the laminæ of the broad ligament to the inferior part of the side of the uterus, where it divides into a number of branches; these also are very tortuous, many of them appear to increase in size as they are entering the structure of this organ; these branches then ramify through the parietes of the uterus in every direction, and anastomose with their corresponding arteries from the opposite side. Some branches of the uterine artery also descend to the vagina, some pass forwards to the bladder, and other ascend in the broad ligament to the Fallopian tube and to the ovaria, and inosculate with the spermati

arteries, branches of the abdominal aorta. The uterine arteries and their branches are greatly enlarged during pregnancy or in diseases of the uterus. The uterine arteries in a fœtal and adult pelvis, when contrasted, present a very remarkable difference as to size.

VII.

ARTERIA VAGINALIS

Arises from the iliac, next to the last described branch, but frequently from it or from the pudic or sciatic artery; it runs along the anterior and lateral part of the vagina towards the perinæum, distributing its branches in this course to the bladder, vagina, and rectum, its ultimate branches anastomose with those of the pudic artery.

The student may now proceed to examine the next order of branches of the internal iliac artery, namely, those which pass out of the cavity of the pelvis, and which are principally distributed to the muscles which are situated on its parietes; these branches are four in number, namely, the *obturator, gluteal, sciatic, and pudic;* of these branches one escapes from the pelvis by the thyroid foramen, three by the sciatic notches.

I.

ARTERIA THYROIDEA VEL OPTURATORIA.

This artery is very irregular in its origin, it more frequently arises from the anterior part of the internal iliac artery, but sometimes from one of its branches,

and it very frequently proceeds from the epigastric artery, a branch of the external iliac, and it often has a double origin, one from the epigastric, and the other from the internal iliac artery, both unite near the thyroid foramen: we sometimes observe, that it has a different origin on the opposite sides of the same subject. When the obturator artery arises from the internal iliac, or from one of its branches, it runs forwards and downwards to the upper part of the thyroid foramen, through which it passes into the groin, and is then distributed to the muscles at the inner side of the thigh.

The student may first examine the connexions of this artery in the pelvis, afterwards in the thigh. As the obturator artery runs from its origin to the thyroid foramen, it lies parallel and inferior to the external iliac artery and vein, superior to the origin of the levator ani muscle, and surrounded by some loose cellular membrane which connects it to the bladder; it is accompanied by the nerve of the same name, the latter lying superior to the artery. In this course the obturator artery gives off several small branches, internally, to the bladder, these communicate with the different arteries of this organ; and externally, to the side of the pelvis, to the psoas muscle, and to the lymphatic glands; these arteries anastomose with branches of the external iliac artery. When the obturator artery arrives near the thyroid foramen, it perforates the pelvic fascia, the superior border of the levator ani, and of the obturator muscle; to these muscles it sends several small arteries; at the thyroid opening it gives off two or three considerable branches, which run

along the internal border of this opening, and are principally distributed to the obturator muscle; some branches also pass more inwardly to the neck of the bladder, supply the cellular membrane behind the pubis, and anastomose with corresponding arteries from the opposite side: I have occasionally seen a considerable branch pass in this direction, to the sides of the prostate gland and thence to the perin um, to supply the place of some deficient branches of the proper pudic artery. Other branches of the obturator artery pass upwards and outwards, and communicate with the epigastric artery. The obturator artery, veins, and nerve, then pass through the upper part of the thyroid foramen; the passage for these resembles an oblique canal, which is bounded below by the obturator ligament and muscles, and above by the ramus of the pubis, which is grooved in an oblique direction; this peculiar form of the canal must tend as a security against the occurrence of hernia in this situation: should such however take place, the vessels must lie upon the superior and external surface of the sac.

The obturator artery then descends into the thigh; to expose it here, the student should divide the pectineus, and the upper extremity of the adductor longus; these muscles should be carefully cut through by small portions only at a time, so as to avoid injuring the branches which they receive. The obturator artery having passed through the thyroid foramen, lies on the obturator externus muscle, and divides into two principal branches, a posterior or external, and an anterior or internal; the former inclines backwards along

the external margin of the obturator foramen, and divides into several branches, which pass in different directions; two or three of these run along the border of this opening, and supply the external obturator, the adductor magnus, quadratus femoris, and the hamstring muscles; one or two small branches pass outwards, and enter the acetabulum by the notch, which is placed at the lower and internal part of this cavity: these branches sometimes arise from the internal circumflex artery; they are distributed to the fat and cellular membrane within the joint, and some of them are conveyed along the interarticular ligament to the head of the femur.

The anterior division of the obturator artery is the larger of the two, it descends between the adductor brevis and longus, and divides into several branches, which are distributed to the muscles at the inner side of the thigh; these branches inosculate freely with the internal circumflex artery, a branch of the femoral; some branches also from the obturator artery pass through the upper extremity of the adductor muscles, and run towards the perinæum and scrotum, and anastomose with branches of the pudic artery; several long branches descend beneath the gracilis and adductor longus, accompanied by the branches of the obturator nerve; these descending branches partly supply the muscles in this situation, and communicate with branches of the femoral and profunda arteries.

These several inosculations between the femoral and obturator arteries, have some analogy to the inosculations that exist between the arteries about the

scapula, and must be of essential service in conveying blood from the internal iliac to the femoral artery, in case the external iliac has been obstructed, and provided the obturator has been derived from the internal iliac artery.

The obturator artery is found to arise from the epigastric so frequently, that the student should consider the course it must take from such an origin to arrive at the thyroid foramen; the relative anatomy of this artery in cases of this variety is very important, and should be particularly attended to, for, in the event of femoral hernia existing, the neck of the sac may be found almost encircled by this vessel. When the obturator artery thus takes its origin from the epigastric, it turns in a tortuous manner inwards and downwards, crossing the crural or femoral ring, sometimes along its posterior border; it then bends down behind the ramus of the pubis, and escaping by the upper part of the thyroid foramen, descends into the thigh, where it terminates in the usual manner. When this artery passes along the anterior part of the femoral ring, and then descends along its internal side, it may be considered as bounding three-fourths of the circumference of this opening, and should hernia exist, the artery will have the same relation to the neck of the sac; in such a case there must be considerable danger of injuring this vessel in dividing Gimbernaut's ligament; it is not, however, always, indeed I believe it is very seldom necessary to separate this ligament from the pubis, for the fascia lata is so much concerned in the structure of this part, that dividing this aponeurosis at the inner

side of the neck of the sac, where it is continuous with Gimbernaut's ligament, will be found in almost every instance sufficient to enlarge the opening, or to relax its inner and anterior part sufficiently to admit of the reduction of the intestine.

Should the obturator artery, when it thus arises from the epigastric, pass along the external and posterior borders of the crural ring, it will not be endangered in the operation for femoral hernia, as it must lie behind the neck of the sac.

II.

ARTERIA GLUTEA,

Is the largest branch of the internal iliac artery, in the adult it appears as its continuation: it arises from the posterior part of this trunk, and runs downwards, backwards, and outwards, through the sciatic notch, forming an arch the convexity of which is directed downwards; it then divides into several branches to supply the gluteal muscles.

The origin of the gluteal artery is covered by the internal and external iliac arteries and veins, also by a large nerve, the communicating branch of the lumbar plexus, which joins the first sacral nerve, sometimes the upper division of this plexus also conceals this artery. Very soon after its origin this artery passes through the sciatic notch, accompanied by the superior gluteal nerve and vein, it turns round the

ilium at the upper and anterior part of this opening, and above the pyriform muscle.

The principal branches of the gluteal artery are distributed to the muscles on the dorsum of the ilium; it seldom gives off any branch of importance while within the cavity of the pelvis; sometimes, however, the ileo-lumbar, lateral sacral, or the middle hæmorrhoidal arteries, arise from this trunk; it also generally gives off a few branches to the pyriform muscle, and to the ilio-sacral articulation.

To expose the gluteal artery, and its branches on the dorsum of the ilium, the subject should be placed on the face or side, and the knee and toes turned inwards; an incision may then be made through the integuments from the upper part of the sacrum to the great trochanter, the surface of the glutæus maximus and medius muscles may be then dissected clean; next divide the glutæus maximus in a line from the posterior superior spinous process of the ilium to the tuberosity of the ischium. In making this dissection several large veins and arteries must be injured; if the edges of this muscle be now separated, and the subjacent cellular membrane removed, the trunk of the gluteal artery, accompanied by one or two large veins, and by the gluteal nerve, may be seen escaping from the sciatic notch, above the pyriform muscle, and between it and the glutæus medius. The gluteal artery, as it emerges from the pelvis lies three inches and a half from the mesial line, or from the spinous processes of the sacrum. This artery now appears like a short trunk or axis, for it immediately divides

into two principal branches, a *superficial* and a *deep* one; these soon subdivide into numerous arteries, which separate and run in a radiated direction: most of these branches appear to rise together, and at first lie almost close to the bone, but they are soon separated into different planes by the muscles on the dorsum of the ilium. The principal branches of the gluteal artery are directed forwards and downwards; a few, however, pass backwards, towards the sacrum and coccyx: these posterior branches, although some of them are of considerable size, have received no particular name.

1. RAMUS SUPERFICIALIS, runs from the sciatic notch upwards and outwards, between the glutæus maximus and medius muscles, and soon divides into several arteries; some of these run towards the sacrum and coccyx, pierce the attachment which the glutæus maximus has to those bones, and divide into different branches; some of which run superficially to the muscles and integuments; others pierce the ileo-sacral ligaments, and ramify on the back part of the sacrum and coccyx; some of these branches are very large, and anastomose with the pudic and sciatic arteries, and with the perforating branches of the lateral sacral. The superficial branch of the gluteal artery sends several branches also forwards and downwards, in the substance of the glutæus maximus muscle; many of these are long and large, they frequently inosculate with each other, and with arteries which perforate the glutæus medius muscle from the deep branches of the gluteal artery.

2. RAMUS PROFUNDUS is the principal branch of the gluteal artery; it passes upwards and forwards between the glutæus medius and minimus, and soon divides into four or five branches, one or two immediately pass into the substance of the ilium: the others may be arranged into three principal sets, a superior, middle, and inferior. The first, consisting of two or three branches, pass forwards in an arched manner towards the anterior spinous process of the ilium, covered by the glutæus medius, and coursing along the convex origin of the glutæus minimus muscle: to both these muscles they send numerous branches; some of these anastomose with those branches of the ileo-lumbar and circumflex ilii arteries, which turn over the crest of the ilium, others communicate near the anterior spine of the ilium, with the external circumflex branches of the femoral artery.

The second, or middle set, in general consist of two considerable arteries, which also run forwards and downwards towards the anterior part of the great trochanter; these are also covered by the glutæus medius, and run across the centre of the glutæus minimus: to both these muscles they distribute numerous branches, and at their anterior margin they inosculate with ascending branches from the external circumflex artery from the femoral. This inosculation may be exposed by dividing the tensor vaginæ femoris, and removing some cellular membrane from between the anterior edge of the glutæus medius and the rectus femoris muscles.

The third, or the descending branch, passes paral-

lel to, but inferior and deeper seated than those last described; this branch runs at first on the glutæus minimus, but soon piercing this muscle, it lies on the ilium, immediately above the capsular ligament of the joint; it then runs towards the anterior inferior spinous process of the ilium, and anastomoses with the external circumflex artery; in its course this artery gives off several branches to the gluteal muscles, to the substance of the ilium, and to the capsular ligament.

The gluteal artery is very regular in its course, and in the general termination of its branches: as it escapes from the sciatic notch, it is covered by the glutæus maximus muscle, and lies at such a depth from the surface, that it is not liable to injury; some of its branches, however, or even the trunk itself, may be divided in punctured or gunshot wounds in this region. Mr. J. Bell relates a case of aneurism of the trunk of this artery, which increased to an extraordinary size. Mr. Bell laid open the sac to a great extent, and then secured the mouth of the gluteal artery with a ligature;* in such a case it would be impossible to expose the trunk of this vessel without opening the sac, for it divides into its different branches at the very margin of the sciatic notch.

We can, nearly, ascertain the position of the gluteal artery on the dorsum of the pelvis, by drawing a line from the posterior spinous process of the ilium, to the midspace between the tuberosity of the ischium and

* See *Bell's Principles of Surgery*, vol. i. p. 421.

the great trochanter; if we divide this line into three, we shall find the gluteal artery emerging from the pelvis at the juncture of its upper and middle thirds.

To expose this artery in the living subject, we should place the patient on his face, turn the toes inwards, and commence an incision about one inch below the posterior spinous process of the ilium, and about an inch external to the side of the sacrum continue this incision for about three inches in an oblique direction towards the great trochanter, through the integuments and subjacent cellular membrane down to the glutæus muscle, then separate the fasciculi of this muscle in the same direction, and to the same extent as the external wound, it may be requisite to divide a few of its fibres; let the sides of the wound be then separated by two broad retractors; a dense aponeurosis, which will next appear, must be freely divided or torn through with the finger, and the branches of the gluteal artery will be exposed; by separating some loose cellular membrane, the trunk of the artery may be seen escaping through the upper and anterior part of the sciatic notch, and lying close to the bone; a curved aneurism needle may be then passed under the artery, and care should be taken not to include the surrounding nerves and veins in the ligature. In a fat or in a very muscular person this cannot be an easy operation, on account of the great depth at which the artery lies from the surface, the unyielding nature of the surrounding parts, and the numerous vessels that must be cut during the operation, the bleeding from which will so obscure the view of the deep-seated

parts, as to render it difficult to distinguish one structure from another. I conceive this operation is only advisable in cases of wounds, or of aneurism the consequence of these: under either of these circumstances, I should prefer this operation to that of tying the internal or the common iliac artery, notwithstanding the latter practice has been recommended by very high authority.

III.

ARTERIA ISCHIADICA,

Arises from the internal iliac artery, anterior to the gluteal; it passes through the inferior part of the sciatic notch, between the pyriform and levator ani muscles, and is distributed to the muscles on the back of the ilium, and to those at the upper and back part of the thigh.

The sciatic artery is smaller than the gluteal, yet it often appears as the continuation of the internal iliac; it has a longer course in the pelvis than the gluteal artery. The sciatic artery from its origin runs downwards and forwards over the pyriform muscle and the sciatic plexus of nerves, it then escapes through the lower part of the sciatic notch, between the pyriform and levator ani muscles, above the lesser sciatic ligament, and in front of the great sciatic nerve; it sometimes passes between the roots of this nerve.

On the dorsum of the pelvis the sciatic artery is covered by the glutæus maximus muscle, but it may

be seen in the same dissection as was made to expose the last described artery. The sciatic artery then descends in the fossa between the trochanter and tuber ischii, but nearer to the latter, and about half an inch to the internal or sacral side of the sciatic nerve: it preserves the form of a trunk but for a short distance, and soon divides into several branches, which are distributed to the muscles in this situation.

While in the pelvis, the sciatic artery sends some small branches to the pyriform and levator ani muscles, to the rectum and bladder, vagina and uterus, and to the surrounding cellular membrane; it very frequently gives off the middle hæmorrhoidal and lateral sacral arteries: the sciatic and pudic also often arise by a common trunk.

When the sciatic artery has passed through the sciatic notch, it sends off several branches in different directions; some of these pass inwardly towards the sacrum and coccyx, others are distributed to the glutæus maximus muscle, but the principal descend on the back part of the thigh, and supply the hamstring muscles, the quadratus femoris, and the adductor magnus. The principal branches of the sciatic artery may be considered as three in number, 1st, *ramus coccygœus*; 2nd, *comes nervi ischiadici*; and 3rd, *rami musculares.*

1. Ramus coccygœus. This is a very large and regular branch; it sometimes appears like a subdivision of the sciatic artery. The coccygeal artery runs inwards and downwards across the pudic artery, pierces the sacro-sciatic ligaments, sends some branches to the posterior surface of the sacrum and coccyx,

which anastomose with the posterior branches of the lateral sacral arteries. The coccygeal artery also supplies the glutæus maximus, and the adipose substance around the extremity of the rectum; these branches communicate with the pudic and hæmorrhoidal arteries.

2. Comes nervi ischiadici. This branch arises opposite the tuber ischii, and takes the course of the sciatic nerve; at first it is but loosely connected to it, but it soon penetrates to its centre, and descends in it to the lower part of the thigh; here this artery is sometimes found larger than it was above, and divides into branches which correspond to the divisions of the nerve. In this course the comes nervi sciatici has frequent communications with those different branches of the femoral artery which supply the muscles on the back part of the thigh. In addition to this artery, several small branches, from different sources, accompany the sciatic nerve, and form numerous inosculations, which, in a minutely injected subject, present a spiral appearance along its whole course: I have found these spiral inosculations large and numerous, and very tortuous, in a limb in which the femoral artery had been obliterated many years previously.

3. Rami musculares. Between the tuberosity of the ischium and the great trochanter the sciatic artery divides into several branches, some of which terminate in the lower part of the glutæus maximus muscle, others descend to the biceps, semi-membranosus, and semi-tendinosus; these branches anastomose with the perforating arteries of the arteria profunda femoris. The other muscular branches of the

sciatic pass deeper than the former, supply the gemini, the obturator and the quadratus femoris muscles; between the inferior edge of this last, and the superior edge of the adductor magnus, two or three branches of the sciatic artery inosculate with the circumflex arteries from the femoral.

The inosculations between the sciatic and femoral arteries must co-operate with those already mentioned in the description of the obturator and gluteal arteries in conveying blood to the lower extremity, in the event of the external iliac artery being obliterated. The sciatic artery emerges from the pelvis about two inches inferior to the gluteal artery, and a quarter of an inch internal to it, or nearer to the sacrum; it is about three inches distant from the mesial line of the sacrum. If a line be drawn from the posterior spinous process of the ilium, to the inferior or most prominent part of the tuberosity of the ischium, the sciatic artery will be found nearly opposite to or a little below the centre of this line. If this perpendicular line be made to terminate at the upper part of the tuberosity of the ischium, then the sciatic artery will be found at its exit from the pelvis, opposite the upper part of the inferior third of this line.

The sciatic artery may be exposed in the living subject by placing the patient in the same position, and dividing the integuments and the glutæus maximus muscle to the same extent and in a similar direction, but about an inch and a half inferior to that recommended in the operation of tying the gluteal artery. The remarks which have been offered when

speaking of the latter operation will apply to the present case.

IV.

ARTERIA PUDICA INTERNA,

Arises in general from the internal iliac artery immediately after the sciatic, but very frequently both these arteries proceed from the internal iliac by a common trunk, which soon subdivides; sometimes, however, this trunk does not give off the pudic until it has passed out of the pelvis through the sciatic notch.

The pudic artery is smaller than the sciatic, it accompanies this vessel out of the pelvis through the great sciatic notch, lying internal and anterior to it; the pudic artery then runs for a short distance on the dorsum of the pelvis, covered by the great sciatic ligament, and by branches of the sciatic artery. The pudic artery then re-enters the pelvis through the lesser sciatic notch, and runs forwards and upwards on the inner side of the tuberosity and ramus of the ischium, and along the edge of the ramus of the pubis, to nearly as high as the pubic ligament, and there terminates by dividing into two branches, one to supply the corpus cavernosum, the other the dorsum of the penis.

The pudic artery in this course forms an arch the convexity of which is directed backwards, the concavity forwards, and the most prominent part of the arch is that portion which is external to the pelvis, and be-

tween the two sciatic notches. In the erect position the pudic artery at first descends almost vertically, it then runs upwards and forwards, converging anteriorly (or at the pubis) to its fellow of the opposite side.

For the purpose of more attentively examining the relative anatomy of this artery, the student may divide its whole course into three stages; the first is within the pelvis, and extends from the origin of the artery to the lower margin of the sciatic notch; this portion of the pudic artery will be wanting in those cases where the sciatic does not give it off until it has passed out of the pelvis. The second includes that short portion of the artery which is external to the cavity of the pelvis, and which extends from the superior to the inferior sciatic notch. The third stage is the longest, and extends from its re-entrance into the pelvis to its termination at the arch of the pubis.

The pudic artery, in the first division of its course, is of very uncertain length, being much longer in some than in others, according as it arises from the internal iliac high in the pelvis, or from the sciatic low down in this cavity. In this part of its course, the pudic artery is surrounded by a quantity of loose cellular membrane; it descends in a tortuous manner behind the bladder and vesiculæ seminales, and in front of the pyriform muscle and sciatic nerve; it lies nearly parallel to the sciatic artery, but internal and anterior to it; it then passes out of the inferior part of the great sciatic notch, internal, or nearer to the sacrum than the sciatic nerve and artery, but partly concealed by the branches of the latter.

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The pudic artery in this part of its course gives several small branches to the bladder, rectum, and vesiculæ seminales: the middle hæmorrhoidal also frequently arises from it. In the female several branches proceed from it to the uterus and vagina.

The pudic artery may be exposed in the second stage of its course, by dividing the posterior part of the glutæus maximus muscle in the same manner as was directed in the description of the two last described arteries; some cellular membrane on the inner side of the sciatic nerve and artery must be then removed, and the external edge of the great sciatic ligament must be cut through. In this part of its course the pudic artery runs obliquely from the lower edge of the pyriform muscle, downwards and inwards, over the spinous process of the ischium, and passes through the lesser sciatic notch, accompanied by the pudic nerves and veins. The tendon of the obturator internus muscle passes out of this notch as the pudic artery enters; the tendon lying external to the artery, or nearer to the ischium.

The pudic artery in this situation gives two or three branches to the sciatic ligaments, and to the tuber ischii, to the glutæus maximus, gemini and obturator muscles, also to the sacrum and coccyx; these branches anastomose with the sciatic and gluteal arteries.

In cases of hæmorrhage from the branches of the pudic artery in the perinæum or penis, I have known some benefit arise from the patient lying on his back on a hard bed, or on a board, with a small piece of cork or wood placed behind each spinous process of

the ischium, so as to press the pudic artery against that point of bone; this position can be borne for a considerable time without much inconvenience.* In the living subject we can ascertain the situation of the pudic artery, by attending to the following directions: place the individual on his face with the lower extremity extended, and the toes turned inwards; feel for the summit of the great trochanter, and for the base, or articulated end of the os coccyx; these two points are on a level; then draw a line from one to the other, and we may be certain that the pudic artery and the spine of the ischium are opposite the junction of the middle and internal thirds of this line, about an inch and a half above the most prominent part of the tuberosity of the ischium, and about two inches from the side of the coccyx.

In a thin person it might be practicable to pass a ligature around the pudic artery in this situation: the patient should be placed in the position above-mentioned; divide the integuments and subjacent cellular membrane by an incision about three inches in length; this should commence about an inch external to the side of the fourth piece of the sacrum, and be continued in an oblique direction towards the root of the great trochanter, that is parallel to the fibres of the

* I first saw this expedient resorted to by Mr. Travers, in St. Thomas's Hospital, in a case of sloughing ulcer in the glans penis in a very emaciated individual; in that case the hæmorrhage was very alarming, and pressure was applied in the manner I have mentioned, and with a decided good effect, when all local applications to the ulcer had failed.

glutæus maximus. The fasciculi of this muscle must then be separated in the direction of the first incision; it may be necessary to cut across some fibres of this muscle. The external edge of the great sciatic ligament must be next divided, and a dense fascia which is continued from it, and which conceals and renders difficult the clean dissection of any of these arteries on the dorsum of the pelvis. The coccygeal branch of the sciatic artery will be thus exposed, and may be mistaken for the pudic artery, which, however, is deeper seated; this branch should be tied and divided. If the finger be now passed to the bottom of the wound, the spine of the ischium may be felt; the pudic artery lies near the point of this process; with the handle of the knife or any blunt instrument this vessel may be separated from its connexions, and if the sides of the wound be held separate, the curved aneurism needle may be passed round the artery; care should be taken not to include the pudic nerves.

The foregoing rules for ascertaining the situation of this and of the gluteal and sciatic arteries, at their exit from the sciatic notch, are given chiefly as points to fix the attention of the dissecting pupil, and not by any means under a conviction of their constant and practical applicability during life. The points of anatomical reference which are selected, are not always sufficiently prominent or distinct to render the measurement of the intervening spaces perfectly accurate; this circumstance, however, the operating surgeon will perhaps have but little cause to regret, when it is recollected, that the operations of tying these arteries

on the dorsum of the pelvis, are alone required in cases of recent wounds or of aneurisms the consequence of wounds. In instances of the former, the direction of the wound will in general serve as the most certain guide to the situation of the divided vessel, and should be preferred to any fixed rule. In aneurisms which will in general be more or less diffused, the relative position of the parts will, in all probability, be so much altered, that it will be found advisable to cut into the sac at once, to clear out the coagula and secure the bleeding vessel with a strong curved needle; the tenaculum or forceps will not I fear avail much, particularly in aneurism of the gluteal artery. Some advise us in such aneurisms to secure the trunk of the internal iliac artery at once, in preference to any attempt to render the operation nominally more simple, by searching for those secondary branches which may be the seat of the disease: although this opinion has been very generally inculcated, and particularly in Mr. Guthrie's late work on Injuries and Diseases of Arteries, I cannot give an unqualified assent to it. The operation of tying the internal iliac artery is no doubt very practicable, but all must admit there is both difficulty and danger attending its execution, as well as in the subsequent stages. I have elsewhere remarked, that diffused aneurisms, the consequence of wounds, are very generally successfully treated by opening the tumour freely, and tying the artery both above and below the wound, or as in the case of the gluteal artery, which, on the dorsum of the pelvis is like a short axis, securing the very wound itself in the

ligature. I have known this practice to succeed in cases of gluteal aneurism, and should therefore recommend it previous to tying the internal iliac, which I would only have recourse to as a "dernier ressource."

The pudic artery having re-entered the pelvis now commences its third stage; this extends from the lesser sciatic notch to the arch of the pubis. This division of the artery is most important in a practical point of view, and should be examined by the student with great attention. The dissection of this portion of the pudic artery may be made in different ways; as the subject lies on the face, the artery may be traced from the sciatic notch along the inside of the tuberosity and ramus of the ischium and pubis, and its principal branches may be thus exposed. I prefer, however, the following method: place the subject in the same position as in the lateral operation for lithotomy, or, as in making the ordinary dissection of the perinæum; fill the lower extremity of the rectum with sponge or curled hair, pass a staff into the urethra, raise the scrotum towards the abdomen, and secure it in that position by a stitch, if the student have no companion to assist him. Make an incision through the integuments of the perinæum from the scrotum to the front of the anus, then around each side of this opening to its back part, and continue it in a straight direction to the coccyx: the skin being now dissected to either side, the cutaneous sphincter and the strong superficial fascia of the perinæum are exposed; this fascia may be divided in the middle line, or detached from the rami of the ischium and pubis on one side,

and raised towards the opposite; the muscles of the perinæum are then partly exposed, being still covered by a very fine and semi-transparent aponeurosis.

In the posterior part of the perinæum is the lower extremity of the rectum, on either side of which is a considerable quantity of adipose substance, filling up the space between the intestine and the tuberosity of the ischium; if the student carefully remove this fat, he will bring into view the side of the rectum and the levator ani muscle, passing from the inside of the pelvis obliquely downwards, to be inserted into this intestine; external to this he may observe the obturator fascia descending along the inside of the ischium to be inserted into the great sacro-sciatic ligament, and ramus of the ischium and pubis; this fascia covers the pudic artery in this situation; several perforations may be observed in it for the transmission of some of the branches of this vessel.

The pudic artery is conducted from the lesser sciatic notch towards the perinæum, by a process of the great sacro-sciatic ligament, which extends from the tuberosity along the ramus of the ischium as far as the crus penis. The pudic artery in this course lies at first between the obturator internus muscle and the fascia of that name; the muscle separates the artery from the bone, and the fascia divides it from the levator ani muscle, and from the cavity of the pelvis. The obturator fascia is in this situation very tense, as it is connected to this process of the great sciatic ligament, as far forwards as the ramus of the ischium, or as far as the base of the triangular ligament of the urethra;

indeed this ligament appears as the continuation of the obturator fascia, from one side of the pelvis across the perinæum to the other.

As the pudic artery runs in this course it is confined in a sort of canal, which is formed internally, or towards the pelvis, by the obturator fascia, externally by the tuberosity and ramus of the ischium, and inferiorly or towards the perinæum by this process of the great sciatic ligament. As the pudic artery runs along the inside of the tuberosity of the ischium, it lies about an inch and a half above the lower surface of this process, and about two inches and a half from the integuments. From the tuber ischii to the crus penis, the pudic artery is, in some degree, defended by the obturator fascia in the lateral operation of lithotomy, from the edge of the knife or of the gorget.

The student should now reflect, that, in the lateral operation of lithotomy, it is in this situation, between the rectum and ischium, that the operator must clear a passage for the extraction of a calculus, and that the middle portion of the levator ani muscle must be there divided; and if he consider the position of the rectum on one side, and of the pudic artery on the other, he will perceive the necessity of lateralizing the knife to such a degree, as to avoid injury to either of these important parts; for if the cutting edge be directed too much outwards, the artery will be endangered; or if it be turned directly backwards, the rectum must be wounded.

The pudic artery in this division of its course gives branches to the lower extremity of the rectum, to the

muscles and integuments of the perinæum, and to the penis and urethra; these branches are, 1st, *arteriæ hæmorrhoidales externæ;* 2nd, *arteria perinæi;* 3rd, *arteria transversalis perinæi;* 4th, *arteria transversa profunda* vel *arteria corporis bulbosi* vel *corporis spongiosi urethræ;* 5th, *arteria corporis cavernosi penis;* and 6th, *arteria dorsalis penis.*

1. ARTERIÆ HÆMORRHOIDALES EXTERNÆ. These arteries are two or three in number; they arise from the pudic artery soon after it re-enters the pelvis, as it runs along the inside of the tuberosity of the ischium; these arteries pierce the obturator fascia, and pass transversely towards the anus, one anterior, another posterior, and sometimes a third to the side of this opening.

The external hæmorrhoidal arteries give numerous branches to the fat, which fills the space between the tuberosity of the ischium and the side of the rectum; some branches also turn over the tuber ischii to the glutæus maximus muscle, and communicate with the gluteal arteries.

The external hæmorrhoidal arteries supply the lower part of the rectum, and anastomose with each other, and with the corresponding arteries of the opposite side; several branches also ascend along the rectum, and meet the descending branches of the middle and superior hæmorrhoidal arteries.

The external hæmorrhoidal arteries are liable to be divided in the operation for fistula in ano and in lithotomy; however, they soon retract within the surround-

ing cellular membrane, and seldom bleed to any alarming degree.

2. ARTERIA PERINÆI. This is a very regular artery, and of very considerable length; it supplies the muscles and integuments of the perinæum.

The perineal artery arises from the pudic, anterior to the branches last described, it immediately pierces the obturator fascia, and the posterior edge or base of the triangular ligament of the urethra, and descends to the perinæum; it then turns upwards and forwards round the transverse muscle of the perinæum, and having entered the triangular space between the accelerator urinæ, and compressor penis muscles, it runs forwards and towards the middle line, supplying the muscles and integuments of the perinæum and scrotum; in which last mentioned part it is ultimately distributed.

In the first part of this course, that is, in the posterior part of the perinæum, the perinæal artery lies very deep, but anteriorly it becomes very superficial this artery throughout its whole course is accompanied by two or three nerves, branches of the pudic; it sends off several branches to supply the muscles and integuments of this region; some of these pass towards the mesial line, and anastomose with the corresponding arteries from the opposite side; others run outwardly over the rami of the ischium and pubis, and communicate with branches from the inside of the thigh. When the perinæal artery has arrived at the scrotum it divides into numerous small but long branches, which ramify in the integuments and sub-

jacent cellular tissue, which in this region appears to possess a peculiar organization. These branches are accompanied by several nerves and veins; these latter are very tortuous, and form a complete network in the dartos; these may be seen during life through the integuments, particularly if the scrotum have been distended by hydrocele, or disease of the testicle; these terminating branches of the perinæal artery inosculate with several small but long branches which proceed from the femoral, obturator, and spermatic arteries.

The perinæal artery is liable to be cut in lithotomy; it may escape by chance, but not by any caution or dexterity on the part of the operator; should it bleed freely, it can be tied without much difficulty, as it lies superficial in the perinæum.

3. ARTERIA TRANSVERSALIS PERINÆI, is a smaller artery than that last described, from which too it frequently arises. The transverse artery of the perinæum in general arises from the pudic immediately after the perinæal artery, it then pierces the obturator fascia and the base of the triangular ligament, descends to the perinæum, and arriving at the transverse muscle, runs along its cutaneous surface, towards the middle line, where it meets the corresponding artery of the opposite side. The transverse artery runs anterior to the anus and posterior to the bulb of the urethra; its branches are distributed to the different muscles of the perinæum, and anastomose with the perinæal and hæmorrhoidal arteries.

In the lateral operation of lithotomy, this artery must be divided; in general, however, it is so small

and throws out so little blood, as not to require a ligature.

4. ARTERIA CORPORIS BULBOSI VEL SPONGIOSI URETHRÆ. This artery, which is larger than that last described, but very short, arises from the pudic artery when that vessel has arrived at the crus penis, and opposite the bulb of the urethra. The artery of the bulb then runs in a transverse direction, between the fibres of the triangular ligament; about a quarter of an inch above the base of this ligament, and at the side of the bulb, (where the triangular ligament is separating into its two laminæ, the anterior of which is connected to the bulb, and the posterior to the membranous part of the urethra), it divides into two branches. One of these descends a little, and enters the anterior prostrate gland, or the gland of Cowper; the other branch, which is much larger, pierces the bulb and ramifies through the corpus spongiosum urethræ; its branches open into the cells of this tissue, and some extend as far forwards as the glans; small branches also perforate the fibrous covering of the urethra, and penetrate the corpora cavernosa penis, others go to the muscles and integuments of the urethra and penis.

In performing the lateral operation of lithotomy, the artery of the bulb is in danger of being wounded at the time of dividing the membranous part of the urethra; this accident may be attended with very severe and alarming hæmorrhage; and which it is sometimes very difficult to restrain, for this artery lies very deep, is surrounded by the triangular ligament, the

fibres of which being very dense and unyielding, prevent the divided vessel retracting freely; its origin from the pudic too is so close to the wounded part that it may bleed profusely. In such a case it is almost impossible to apply a ligature on this vessel with the tenaculum; the common dissecting forceps may prove a more convenient instrument, with which to seize and draw out the wounded artery; I have, however, seen it necessary to use the curved needle, and so include the surrounding parts in the ligature.

This artery does not, in every case in which it has been opened, bleed much at the time of the operation; but in a few hours afterwards the patient may complain of a sensation of weight and uneasiness about the rectum and at the wound, also an inability to pass urine, with a strong desire to do so; in addition to these distressing symptoms he becomes cold, pale, and faint; in such a case the surgeon may find it necessary to place the patient nearly in the same position he was in during the operation, and re-open the wound; he should next remove the coagula of blood which fill the cavity of it, as well as those which extend into the bladder; he should then search for the bleeding vessel; it may perhaps be only some small artery between the muscles, which, by bleeding internally, has given rise to such unpleasant symptoms; if so, it can be easily secured with the tenaculum and ligature: but if the artery of the bulb have been wounded, it lies so deep that it will be almost always necessary to have recourse to the curved needle: should this fail to repress the hæmorrhage, we must rely on the effects of

pressure; in such a case graduated compression applied from the bottom of the wound will not prove effectual, for the fibres of the triangular ligament will not only bear off the pressure from the wounded vessel, but may also have the injurious effect of directing the blood into the bladder, and of confining blood and urine in this reservoir. The pressure should, therefore, be so adapted, as while it compresses the artery, it may not obstruct the flow of urine from the bladder through the wound; this twofold indication may be effected by passing a gum elastic catheter, or a small silver canula, through a piece of sponge: the canula is to be directed into the bladder, and the sponge is to be passed deep into the wound; the expansion of this substance will repress the hæmorrhage, particularly if aided by proper general treatment.

A wound of the artery of the bulb, in the adult, I should apprehend, might be attended with nearly as great danger as of the pudic artery itself; and, therefore, in performing the lateral operation of lithotomy, every precaution should be taken to guard against this accident. This artery will be avoided in this operation, if we open the urethra behind the bulb and behind the triangular ligament, and not cut through this substance; a very few fibres only of the base of this ligament require division, and the membranous part of the urethra should be opened just in front of the prostrate gland. As the staff lies in the membranous part of the urethra, its lower or grooved edge will be found to be about one inch inferior to the arch of the pubis. If we introduce the knife into the urethra in front of

the triangular ligament, or at too high a point, that is, too near the arch of the pubis, we shall certainly divide the vessel I have just described.

5. ARTERIA CORPORIS CAVERNOSI PENIS. When the pudic artery has arrived at the ramus of the pubis, it pierces the triangular ligament, and runs between the bone and the crus penis; in this situation it divides into its two terminating branches, viz., the artery for the corpus cavernosum and that for the dorsum of the penis. The artery to supply the corpus cavernosum enters the crus penis obliquely, and runs through the centre of this organ, inclining towards the septum, and distributes its branches to either side; these branches open into cells, from which the corresponding veins take up the blood, as some suppose, by a power similar to the process of absorption. The arteries of opposite sides communicate with each other through the septum of the penis, they also send off many perforating branches which pass to the lining membrane of the urethra, and to the muscles and integuments of the penis.

6. ARTERIA DORSALIS PENIS. This is the last branch of the pudic artery, of which it appears the continuation; this artery ascends between the crus penis and the ramus of the pubis, and then runs in front of the pubic ligament, approaches the artery from the opposite side, with which it inosculates, or unites so as to form but a single vessel, and accompanied by the dorsal veins and nerves of the penis, it passes forwards and upwards between the laminæ of the suspensory ligament, and then continues its course along the dor-

sum of the penis, in the groove between its crura, as far as the corona glandis. In this course the dorsal artery is covered by the integuments and by the superficial fascia.

The dorsal arteries of the penis in many cases appear to enlarge near their termination; they anastomose very frequently with each other; they also send numerous branches to the integuments, some of which anastomose with branches from the femoral, obturator, and perinæal arteries. When these arteries have arrived near the glans penis, they each divide into several branches, which encircle the corona glandis, unite with each other, and send numerous branches to the prepuce, and into the glans; these last anastomose with the arteries of the corpus spongiosum urethræ.

In amputation of the penis, the arteries of the dorsum and of the corpora cavernosa may require to be secured by ligatures; they generally retract from the surface of the wound as soon as divided; the surgeon should, therefore, tie them. In some cases it will be necessary to tie four or five arteries, in other instances none of these branches will bleed to that degree as to require a ligature.

In my dissections of the arteries, I have occasionally observed that the pudic artery on one or both sides appeared unusually small; and on more accurate examination in such cases, I have found that the internal iliac had given off a distinct branch, which ran along the side of the bladder and prostrate gland, and passing beneath the arch of the pubis with the dorsal veins, became the dorsal artery of the penis: should

such a variety exist in one who was to become the subject for the lateral operation of lithotomy, I fear this artery must be wounded; and judging from its size and situation in those cases in which I have seen it take this course, I should apprehend very serious consequences from its division; it is not improbable, but that some of those alarming and fatal cases of hæmorrhage which have occurred even to the best operators, may have depended on this variety: this irregular branch I have seen to arise from the obturator artery.*

I may observe, that I have noticed this variety very frequently in children under eight years of age, but as yet I have only met with three instances of it in the adult.

In the child the pudic artery is very small in proportion to its size in the adult; the corpus spongiosum urethræ, and the corpora cavernosa penis, being but little developed at this early age, their cells never being fully distended may account for the comparatively small size of the pudic artery, or of those branches which supply these organs; the muscles and integuments of the perinæum and penis, however, are as freely supplied with blood at that age as afterwards; this may probably account for the perinæal branches and the dorsal arteries of the penis being larger in proportion in the child, than the other branches of the pudic artery.

* A similar variety has been observed by Haller, Burns, and Barclay.

The pudic artery in the female has a similar origin and course to that in the male; there is also a considerable analogy in the distribution of its branches in the two sexes; in the female, however, it is rather smaller; in the pelvis it gives off several branches to the uterus and vagina, and in the perinæum it sends corresponding branches to those in the male subject, and ends in two branches, one to supply the crus, the other the dorsum of the clitoris.

Before the student proceeds to the dissection of any other artery, I should recommend him to re-examine the relative anatomy of the branches of the internal iliac artery; if he have not yet opened the pelvis, he may now make a section of this cavity by cutting through one ilio-sacral articulation, and with a saw divide the pubis of the same side between the symphisis and the thyroid foramen; he will thus obtain a more satisfactory view of the branches of the iliac artery in the pelvis, and he can then also better comprehend the course of the pudic artery, and the relative anatomy of the parts concerned in lithotomy.

ARTERIÆ ILIACÆ EXTERNÆ.

Each of the external iliac arteries in size and in direction appears as the continuation of the common iliac, and in the adult subject is considerably larger than the internal iliac. The external iliac is somewhat larger than the subclavian artery, and as the latter, which is destined to supply the superior extremity, continues undivided as far as the bend of the elbow, and receives different names according to the regions through which it passes; so the great trunk from which the inferior extremity derives its principal supply of blood, (successively denominated from the regions through which it extends, iliac, femoral, and popliteal), runs in an undivided course as far as the knee-joint, where from its first division arise the anterior and posterior tibial arteries. These arteries derive their names from their running nearly parallel to the tibia, one on its anterior, the other on its posterior surface, and they terminate in a free inosculation with each other in the foot.

The student will find it useful to attend to these divisions, and to study the relative anatomy of the artery of the lower extremity in each of these situations.

That portion of the artery which extends from the division of each common iliac, as far as the inferior border of Poupart's ligament, is generally named the external or anterior iliac artery; from this ligament the continuation of the same vessel receives the name

of femoral artery, which name it retains throughout the two superior thirds of the thigh, or until it has arrived at the opening in the tendons of the triceps: and from this to a short distance below the bend of the knee-joint, or to the lower margin of the popliteus muscle, it assumes the name of popliteal artery.

The external iliac arteries of opposite sides agree so accurately with each other in their course and termination, also in their relations and in the number of their branches, that one description will serve for both.

From the division of the common iliac arteries, each external iliac separates from that of the opposite side, and passes downwards and outwards, as far as Poupart's ligament. A line drawn from the umbilicus to a point about half an inch to the pubic side of the centre of this ligament, on either side, will represent the course of these arteries.

But little dissection is required to expose the external iliac artery; the abdominal muscles being laid down towards the thigh, and the peritoneum torn from its loose attachments to the iliac fossa, the whole course of this artery is brought into view.

The external iliac artery descends along the inner side of the psoas muscle, to which it is connected by a thin membrane, which is derived from the iliac fascia external to this vessel, and which is then reflected over the iliac artery and vein, and descends into the pelvis. This membrane is so thin that these vessels are distinctly seen through it; it is, however, suffi-

ciently strong to prevent the artery being displaced or separated from the vein.

In the upper part of its course, the external iliac artery has only some loose cellular membrane behind it, as it descends it becomes more closely connected to the psoas muscle, and has the iliac fascia posterior to it; and when it has arrived near Poupart's ligament, it rests on the psoas, which is here supported by the pubis; in this situation the external iliac artery may be compressed during life. Its accompanying vein lies to its internal side, and at first rather posterior to it, but near Poupart's ligament it is on the same plane as the artery, and rests on the pubis, and upon a few fibres of the psoas and pectinæus muscles. The anterior crural nerve descends along the external or iliac side of the artery, separated from it by the psoas; it also lies on a plane posterior to the artery, being covered by the iliac fascia, and imbedded between the psoas and iliac muscles. Two or three small branches from this nerve, and from the lumbar plexus, are connected to the artery, and descend along its external ide; these branches are distributed to the spermatic cord and to the integuments in the groin; small filaments from these nerves are sometimes seen passing across the artery and vein, and running towards the crural ring. A great number of lymphatic vessels accompany this artery; they principally ascend from the thigh on the pubal side of this vessel; if, however, they have been minutely injected with quicksilver, many will be found encircling the external iliac artery and vein.

The external iliac artery in this course is covered by the peritoneum, which, however, is very loosely connected to it.

When the external iliac artery is fully distended by injection, it appears to be convex forwards inferiorly, and concave forwards superiorly; when empty it is nearly straight; in the old subject it is sometimes a little tortuous, and appears somewhat depressed into the cavity of the pelvis.

The external iliac artery in the upper part of its course gives small branches only to the psoas and iliac muscles, and to the surrounding cellular membrane and lymphatic glands; none of these branches are sufficiently large or regular to receive distinct names; but near Poupart's ligament, two branches of considerable size almost always take their origin from the external iliac, namely, the epigastric and circumflexa ilii.

I.

ARTERIA EPIGASTRICA.

This artery is one of considerable size, and very regular in its origin and course; it supplies the anterior part of the abdominal parietes, and inosculates with the internal mammary arteries.

To trace this artery, the student may either throw down the abdominal muscles towards the thigh, and detaching the peritoneum from these, the whole course of this vessel will be brought into view; or without

opening the abdomen, he may expose this artery by dividing the integuments, the inferior portion of the abdominal muscles, and the fascia transversalis, in the direction of the artery: that is, from the groin towards the umbilicus; I should recommend the student to dissect this vessel according to each of these plans on the opposite sides of the subject.

The epigastric artery generally arises from the external iliac about a quarter or half an inch above Poupart's ligament; but sometimes it arises immediately behind this line, and in some cases it proceeds from the femoral and even from the internal circumflex artery. When the epigastric artery arises higher than Poupart's ligament, it first descends to reach this, and then turns forwards and upwards, thus making an arch, which is convex inferiorly, into the concavity of which the peritoneum descends; when it arises immediately behind or below Poupart's ligament, its course is then directly forwards and upwards. From Poupart's ligament the epigastric artery inclines a little inwards across the iliac vein, it then ascends obliquely towards the rectus muscle, and passes behind the superior angle of the abdominal ring. This artery is covered by the integuments, by the inferior portion of the oblique and transversalis muscles, also by the spermatic cord and fascia transversalis, and ultimately by the rectus muscle; it at first lies on the peritoneum, and shortly after its origin it passes in front of the vas deferens, as this duct is passing towards the pelvis. When the artery arrives at the rectus muscle, it en-

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ters the sheath of this muscle, which then separates it from the peritoneum.

As the epigastric artery lies behind the inguinal canal, it is about a quarter of an inch to the pubic side of the internal abdominal ring; in this situation the vas deferens may be observed almost to hook round this artery, for as that duct lies in the spermatic cord, and of course in the inguinal channel, it is anterior to the epigastric artery, but as it passes through the internal abdominal ring, it lies on its external or iliac side, separated from it by the spermatic artery; and lastly, as the vas deferens is inclining inwards and backwards towards the pelvis, it lies behind this artery. As the epigastric artery ascends from the inguinal canal towards the rectus muscle, it lies internal and nearly parallel to the linea semilunaris; it is accompanied by a large vein, which lies to its pubic side; sometimes there are two epigastric veins, one on either side of the artery.

The epigastric artery gives off several branches; first, as it passes behind the spermatic cord it sends two or three branches to the cremaster muscle; these descend in the cord, and communicate with the proper spermatic arteries; these branches are sometimes very much enlarged in disease of the testicle. Secondly, as the epigastric artery ascends towards the rectus, it gives off several branches, particularly from its external side; these are distributed to the abdominal muscles and to the peritoneum; several branches also pass through openings in the tendon of the external oblique muscle, these supply the integuments, and inosculate

with the external epigastric from the femoral artery. Thirdly, when the epigastric artery has entered the sheath of the rectus, it divides into numerous branches, which ascend between the fibres of this muscle, principally near its posterior surface; at the umbilicus these branches meet corresponding branches from the opposite side, and descending branches from the internal mammary, and intercostal arteries.

In the marsupial animals, as the Kangaroo, the epigastric arteries are larger, to supply the pouch and the mammary glands.

The student should particularly study the relations of the epigastric artery to the parts concerned in hernia. Inguinal hernia is either oblique or direct; the former commences at the internal abdominal ring, and takes the course of the spermatic cord; if a stricture exist at the neck of the sac, that is, at the internal abdominal ring, the edge of the bistoury should be directed upwards and outwards, so as to avoid the epigastric artery. Direct inguinal hernia protrudes from the abdomen directly through the external abdominal ring; if the stricture exist in the neck of the sac in this form of hernia, it should be divided by turning the edge of the bistoury upwards and inwards. If hernia be of recent occurrence, no matter whether it be oblique or direct, the rule of cutting directly upwards in all cases may be adhered to; but should the disease have been of long standing, the sac may be found to have so altered the course of the epigastric artery, that this vessel will, in some cases, be found to encircle three-fourths of the neck of the tumour: and

if the edge of the knife were turned directly upwards, the artery must be divided. If a stricture exist below the neck of the sac in any part of the spermatic channel, it may be divided in any direction, a the epigastric artery is behind the fascia transversalis.

In femoral hernia, the epigastric artery runs very near the anterior part of the neck of the sac, and might be wounded in the operation, if the edge of the knife were directed forwards and outwards.

Should this artery be accidentally wounded in the operation for strangulated hernia it must be more fully exposed by an incision made in its direction, and then secured by ligature.

Although the epigastric artery during health ascends internal, or nearer to the linea alba than to the linea semilunaris, and will not be endangered in the operation of paracentesis of the abdomen, yet in ascites the recti muscles become so much expanded, that in performing this operation we should recollect, that this artery and the linea semilunaris lie more externally, or nearer to the ilium, than natural.

II.

ARTERIA CIRCUMFLEXA ILII.

This artery arises from the anterior and external part of the external iliac, opposite to, or a little lower down than the origin of the epigastric; its course is upwards and outwards towards the spine of the ilium, where it divides into numerous branches to supply the iliac and abdominal muscles.

The circumflex ilii artery may be exposed by throwing down the abdominal muscles, and removing some cellular membrane on the inside of Poupart's ligament; a white tendinous line may then be seen extending from the iliac artery to the spine of the ilium; this line is about a quarter of an inch within Poupart's ligament, and marks the attachment of the iliac and transverse fasciæ to it and to each other; if this line be divided, this artery will be exposed.

The circumflex ilii artery from its origin runs upwards and outwards, towards the anterior superior spinous process of the ilium, and passes across the psoas and iliac muscles, and the anterior crural nerve. In this course it gives off some small arteries to the inguinal glands, and to the muscles on either side; at the spine of the ilium it sends several branches upwards to the abdominal muscles; some of these ramify between the transversalis and internal oblique, and some between the latter and the external oblique muscle. The continuation of the circumflex ilii artery then passes backwards along the internal surface of the crest of the ilium, and meets the ilio-lumbar artery from the internal iliac. In this course the circumflex artery sends off numerous branches, some of which descend to supply the iliac muscle, others ascend to the abdominal muscles; small branches also turn over the crest of the ilium to the glutæi muscles, and anastomose with the gluteal arteries. The anastomosis between this artery and the ileo-lumbar, forms a very free communication, one which must be of essential service in maintaining the circulation in the

lower extremity, in case the external iliac artery has been obliterated.

The external iliac artery may require to be tied in cases of wound or aneurism of the femoral artery, or in case of secondary hæmorrhage after this artery has been tied for popliteal aneurism.

The external iliac artery has been very frequently the subject of operation, and has been attended with more success than has followed similar operations on other arteries. The communications between the branches of the internal iliac and femoral arteries are so free and numerous, that little doubt can be entertained as to the probability of their carrying a sufficient supply of blood for the nourishment of the extremity, in case the main artery becomes obstructed. Observations in the living subject of cases of inguinal aneurism, in which the disease had cured itself by the sloughing of the sac, and consequent obliteration of the artery, has proved that the anastomosing branches are capable of thus maintaining the circulation. Experiment in the dead subject also confirms this opinion, for if the external iliac artery be tied, and fine injection forced from the internal iliac or from the aorta, the limb on that side will be injected equally with the other.

The principal channels through which the communication is maintained, when the external iliac artery has been obliterated, are the ileo-lumbar and circumflexa ilii arteries anteriorly; the obturator and internal circumflex arteries internally; the gluteal and external circumflex arteries externally; and the gluteal,

sciatic, pudic, circumflex, and perforating arteries posteriorly.

Mr. Abernethy first performed the operation of tying the external iliac artery; Mr. Hodgson gives an account of twenty-two instances in which this operation has been performed, in fifteen cases of which there was a complete recovery; in this city this artery has been frequently tied with success. Mr. Hodgson very properly remarks, that the number of cases in which this operation has succeeded, so much exceeds the number of those in which it has terminated unfavourably, that it may be regarded as decidedly established, that the external iliac artery may be tied with as much safety as any artery to which a ligature has been applied for the cure of aneurism. Indeed the success which has followed this operation, has so far exceeded that which has attended the operation of tying the femoral artery for the cure of popliteal or femoral aneurism, that some surgeons have suggested the propriety of performing the iliac operation in the first instance for the cure of those diseases.

Different plans have been recommended for exposing the external iliac artery. The following is the method which Mr. Abernethy pursued, in order to pass a ligature around this vessel: the patient being placed upon a table in a horizontal position, an incision three or four inches in length is to be made through the integuments of the abdomen, in the direction of the external iliac artery. This incision will be situated about an inch and a half from the anterior superior spine of the ilium, towards the linea alba, and nearly

an inch on the outside of the external abdominal ring; the lower extremity will terminate about half an inch above Poupart's ligament. The sides of this incision being separated, the aponeurosis of the external oblique muscle will be exposed, and is to be divided throughout the extent of the external wound: the finger is then to be introduced underneath the inferior margin of the internal oblique and transverse muscles, so as to protect the peritoneum, whilst the operator divides these muscles with a knife or a probe-pointed bistoury. The finger is then to be passed beneath the peritoneum, and this membrane to be pushed upwards and inwards, by the side of the psoas muscle; the pulsation of the artery may be then distinctly felt about two inches above Poupart's ligament. The external iliac vein is situated on the inside of the artery; the psoas muscle lies between the artery and the anterior crural nerve. The artery and vein are connected together by dense cellular membrane, which is to be separated with the nail, or cautiously divided with a knife, so as to enable the operator to introduce the point of the aneurism needle between the artery and vein, and bring it out on the opposite side of the former; the ligature, which is thus conveyed round the artery, being secured, the wound is to be closed with strips of adhesive plaster. When the patient is placed in bed, the thigh should be bent upon the pelvis, so as to place the artery in a relaxed condition.*

* See Hodgson on Diseases of the Arteries, p. 419, and Abernethy's Surgical Works, vol. i.

The advantage of this mode of performing this operation is, that the external iliac artery may be tied very high up in the abdomen; it is, therefore, peculiarly applicable to cases of inguinal aneurism, in which the tumour has extended as high as Poupart's ligament, and where we are desirous to tie the artery at some distance from the disease.

Sir A. Cooper performs this operation in the following manner: he makes a semilunar incision, the convexity of which looks downwards and outwards through the integuments in the direction of the fibres of the aponeurosis of the external oblique muscle; one extremity of this incision will be situated near the spine of the ilium; the other will terminate a little above the inner margin of the abdominal ring. The aponeurosis of the external oblique muscle will be then exposed, and is to be divided throughout the extent and in the direction of the external wound; the flap, which is thus formed, being raised, the spermatic cord will be seen passing under the margin of the internal oblique and transverse muscles. The opening in the fascia which lines the transverse muscle, through which the spermatic cord passes, is situated in the mid space between the anterior superior spine of the ilium, and the symphisis pubis; the epigastric artery runs precisely along the inner margin of this opening, beneath which the external iliac artery is situated. If the finger, therefore, be passed under the spermatic cord through this opening in the fascia which lines the transverse muscle, it will come into immediate contact with the artery, which lies on the outside of the ex-

ternal iliac vein. The artery and vein are connected together by dense cellular membrane, which must be separated, to enable the operator to pass a ligature, by means of an aneurism needle, round the former.

According to this plan, this operation may be performed with very little disturbance to the peritoneum, and but little injury to the abdominal parietes; the artery lies very superficial, immediately above Poupart's ligament, and, therefore, the operation, according to Sir A. Cooper's plan, is more easily and expeditiously performed, particularly in a robust or corpulent person, than according to the mode adopted by Mr. Abernethy, and may therefore, in general, be preferred.

ARTERIA FEMORALIS.

When the external iliac artery has passed below Poupart's ligament, the name of femoral is given to this great vessel; and this name it retains until it arrives at the opening in the tendon of the triceps, through which it passes into the popliteal space, where it receives the name of popliteal artery.

If the distance between Poupart's ligament and the knee-joint be divided into three equal portions, the femoral artery will be found to extend through the two superior, and the popliteal through the inferior third.

The course and connexions of the femoral artery the student may now proceed to examine; at first, therefore, the dissection may be confined to the superior and middle thirds of the thigh; place the limb in the following position: as the subject lies on the back, bend the knee and rotate the limb outwards as much as possible, so that the inner side of the thigh may look forwards; then raise the integuments from the anterior part of the limb, from Poupart's ligament, to within three or four inches of the knee; a large cutaneous vein is then exposed, the internal saphena; this vein ascends from the inner side of the leg and knee, along the internal and anterior part of the thigh towards the groin; in this course it lies on the fascia lata, which membrane it perforates about two inches below Poupart's ligament, and then joins the femoral

vein. Two or three large lymphatic glands are generally found in this situation; they lie parallel to the vein, and in some cases one of them lies behind this vessel. The opening in the fascia lata, through which the saphena vein passes, is of a semilunar figure, the concavity looking upwards; it is best seen by dividing the vein on the thigh, and raising it up towards the groin; although the edge of this opening appears sharp, yet from it the fascia is reflected backwards and downwards, and is lost on the sheath of the femoral vessels.

As the saphena vein ascends on the inside of the thigh, it lies on a plane internal to the femoral artery, and may, therefore, be avoided in the living subject in the operation of tying this vessel. In the groin the saphena vein frequently receives one or two considerable veins from the anterior and external part of the thigh, as well as several branches from the conglobate glands in this region. In the space between the termination of this vein and Poupart's ligament, several lymphatic glands are situated; these are attached to the superficial fascia, some lying beneath it, others between its laminæ; some of these glands lie on, and are parallel to Poupart's ligament, others lie over the femoral vessels, and are connected to these by several small arteries and veins.

If the student now proceed to remove the superficial fascia and the lymphatic glands, he may remark the intimate connexion between this membrane and the fascia lata, a little below Poupart's ligament; hence it is, that these glands are bound down by the superficial

fascia, and hence is the principal source of that difficulty which is occasionally experienced in distinguishing between diseases of these glands, and of the subjacent vessels. Ulceration in the inguinal glands may extend to the coats of the femoral artery, and so give rise to hæmorrhage, which may be suddenly fatal, or may require the operation of tying the iliac artery.

The student may next observe the connexions of the fascia lata in this situation; between the termination of the saphena vein and Poupart's ligament this fascia may be divided into three portions, an internal, middle, and external; the internal or pubic portion covers the pectineus and adductor muscles, and is attached superiorly to the linea innominata or ileo-pectinea, anterior to the attachment of Gimbernaut's ligament; internally it extends over the gracilis and the adductor muscles, and is inserted into the ramus of the ischium and pubis; externally it passes behind the sheath of the femoral vessels, and is attached to the fascia iliaca, and to the capsular ligament of the hip-joint. The middle portion of the fascia lata is very thin, and has been termed the cribriform portion; it extends from the saphena vein to Poupart's ligament, is connected on either side to the pubic and iliac portions of the fascia lata, and posteriorly to the fore part of the sheath of the femoral vessels, which in this situation is derived from the fascia transversalis. The cribriform fascia covers the femoral vessels, and is perforated by the arteries and veins of the inguinal glands, and by the lymphatic vessels passing up to the

iliac glands; this portion of the fascia lata is more closely connected than any other to the superficial fascia. The external or iliac portion of the fascia lata is very dense and strong, it is continued from the external surface of the thigh, and is intimately attached superiorly to the spine of the ilium, and to Poupart's ligament; and uniting with the cribriform fascia, is continued in front of the femoral vessels, along with the inferior fibres of Poupart's ligament, and is inserted along with these into the linea innominata, thus assisting to form the external part or the base of Gimbernaut's ligament. If the cribriform fascia be removed along with the superficial fascia, then the iliac portion of the fascia lata will present the appearance of a crescentic or falciform process, extending across the femoral vessels, the concavity of which process will look downwards and inwards.

The fascia lata covers the different muscles, nerves, and vessels, in the inguinal region,* and must, therefore, be divided, to expose the several parts in this situation. This region may be considered to occupy the upper third of the fore part of the thigh, and to be of a triangular figure, the base, superiorly, formed by Poupart's ligament, and the apex, inferiorly, by the meeting of the sartorius and adductor muscles; the external or iliac side, which is on a plane anterior to

* The term inguinal region is differently applied by different authors, by some to the spermatic channel and adjacent parts, and by others to the upper part of the front of the thigh; it is in the latter sense the term is used above.

the pubal, is formed by the sartorius, iliac, and rectus muscles, and the internal or pubal side by the pectinæus and adductor longus muscles.

Through this region the femoral artery passes obliquely downwards, backwards, and inwards, somewhat in a spiral manner in reference to the thigh bone, for, superiorly this vessel lies anterior to the femur, in the middle it lies internal to it, and in the popliteal space the artery is behind the bone.

A line drawn from the centre of Poupart's ligament to the inner edge of the patella, will be nearly parallel to the course of the femoral artery.

The student should first examine the connexions of the femoral artery in the upper, and afterwards in the middle third of the thigh: to expose it in the first division of its course, it is only necessary to divide the fascia lata from Poupart's ligament to the meeting of the sartorius and adductor muscles, when by removing a little cellular membrane, the sheath of the vessel will be brought into view.

In the superior third of the thigh the femoral artery is covered only by the integuments, superficial fascia, some lymphatic glands, and by the fascia lata; and inferiorly the sartorius muscle overlaps it a little. In this division of its course the femoral artery is first placed on the psoas magnus, which muscle is here supported by the acetabulum, by the head of the femur, and by the capsular ligament; below this the femoral artery has no support immediately behind it, but lies on a quantity of cellular membrane, and on several branches of veins and arteries, which separate

it from the insertion of the pectinæus and adductor brevis muscles, over which muscles the artery passes, but at a considerable distance from them, particularly if the limb be turned inwards; if, however, the thigh be rotated outwards, the lesser trochanter and the muscles which are inserted below it are then brought forward, so as to lie nearer to the artery. The femoral artery next lies on the tendon of the adductor longus muscle, and then pursues its course through the middle third of the thigh, where we shall examine it afterwards.

In the superior third of the thigh then, the femoral artery is very superficial; during life it can be felt pulsating through the entire of this part of its course, but particularly strong immediately below Poupart's ligament; it here, in the extended state of the thigh, appears pushed forwards by the acetabulum and head of the femur, from both which, however, it is separated by the fleshy fibres of the psoas.

Behind the psoas muscle in this situation, is a large bursa mucosa, which lies on the pubis and on the capsular ligament, it sometimes communicates with the joint; if this bursa be distended, as it sometimes is after violent exercise, or in inflammation of the joint, it will form a tumour in the groin, behind and around the artery; this tumour may in some respects resemble aneurism, from which, however, it can be discriminated by making a careful examination, the thigh being flexed, so as to relax the fibres of the psoas and iliac muscles.

The femoral vein lies very close to the artery in this

part of its course; immediately below Poupart's ligament it lies to its pubic side, and rests upon a few fibres of the psoas, and upon the pubis between this muscle and the pectinæus; as it descends it gradually inclines behind the artery, so that at the tendon of the adductor longus the vein is covered by the artery, and is very intimately attached to it.

The anterior crural nerve lies about half an inch to the iliac side of the femoral artery, immediately below Poupart's ligament, and is deeply imbedded between the iliac and psoas muscles; but three or four of its branches soon approach the artery, and descend along the external side of its sheath; small branches of these nerves also sometimes pass in front of its sheath to the adductor muscles, and one long branch (nervus saphenus) enters the sheath opposite the upper edge of the tendon of the adductor longus, and may be afterwards traced down the middle third of the thigh, along the outer and anterior part of the artery.

The student may now proceed to examine the femoral artery in the middle third of the thigh; to expose it in this part of its course the sartorius must be drawn to one side after the integuments and fascia lata have been raised; behind the sartorius is a very strong fascia, composed of tendinous fibres, which proceed in a transverse direction from the vastus internus to the tendons of the adductor magnus and longus muscles; this aponeurosis commences superiorly where the sartorius is first passing in front of the artery, and is here very thin, but about the middle of the thigh it is very

dense; it terminates at the upper part of the inferior third, in a well defined edge, beneath which passes the saphena nerve and a small artery: if this fascia be divided, the femoral artery and vein will be exposed.

As these vessels descend along the middle third of the thigh, they lie in a sort of tendinous canal; this canal is of a triangular figure, and is bounded anteriorly by the fascia just now described; externally by the vastus internus; internally by the tendon of the adductor longus and magnus; and posteriorly by the conjoined tendons of the vastus internus and adductor muscles; which tendons are united to each other for at least one inch before they arrive at the linea aspera, into which they are inserted. In the middle third of the thigh the femoral artery lies to the internal side of the femur, but is separated from the bone by the vastus internus muscle: during this part of its course the femoral vein lies posterior to the artery, and is very closely connected to it; the saphena nerve is here enclosed in this sheath of the artery, and lies on the anterior and external part of this vessel.

At the lower part of the middle third of the thigh the femoral artery and vein pass into the popliteal space, through an opening between the tendons of the triceps and vastus internus muscles; this opening is of an oval figure, its edges are tendinous, so that the contraction of the surrounding muscles cannot interrupt the circulation in these vessels; this opening is bounded superiorly by the tendons of the adductor longus and magnus; externally, by the vastus internus; internally, by the tendon of the adductor mag-

nus; and inferiorly, by the conjoined tendons of the last named muscle, and of the vastus internus. The saphena nerve does not accompany the femoral artery through this opening, but continues its course down the inside of the thigh, covered by the sartorius muscle; at the knee this nerve lies between the tendons of the gracilis and sartorius, it then becomes a cutaneous nerve, and accompanies the saphena vein along the inner side of the leg as far as the internal ankle.

The student may postpone the examination of the popliteal artery until he has dissected the branches of the femoral, as well as considered the practical inferences which may be deduced from an attentive consideration of the relative anatomy of this vessel. The femoral artery in its course through the superior and middle thirds of the thigh, gives off several branches to supply the integuments and muscles of this region.

In the superior third of the thigh it sends off four principal branches, three of which supply the lymphatic glands in the groin, and the integuments of the abdomen; these three branches are named the *arteria epigastrica superficialis, arteriæ pudendæ externæ, and arteria circumflexa ilii superficialis;* the fourth is a very large branch, and is named the *arteria profunda femoris;* this artery arises about two inches below Poupart's ligament, and supplies the principal muscles of the thigh, and may be considered the proper artery of this region, while the continued femoral or crural artery is destined to the leg. Besides these four branches, the femoral artery, in the superior third

of the thigh, sends off several small and unnamed branches to the sartorius, iliacus, pectinæus, and adductor muscles, and to the surrounding cellular membrane. In the middle third of the thigh the femoral artery gives off several branches to the muscles which surround it; and as it is about to become the popliteal artery, it gives off a long branch which descends to the inner side of the knee-joint, named arteria anastomotica magna; these several branches the student may now proceed to expose.

I.

ARTERIA EPIGASTRICA SUPERFICIALIS.

This artery arises from the fore-part of the femoral artery, about half an inch below Poupart's ligament; in size it is inferior to the internal epigastric, nearly parallel to which it runs. The superficial epigastric artery pierces the fascia lata, and turns over Poupart's ligament, and ascending on the abdominal muscles, is only covered by the integuments; it runs towards the umbilicus, where it ends in an anastomosis with small branches from the internal epigastric, and from the mammary arteries. The superficial epigastric artery, immediately after its origin, gives off small branches to either side, to the inguinal glands; and as it ascends on the abdomen, its branches are distributed to either side, to the integuments and superficial fascia; all these branches are accompanied by corresponding veins. The superficial epigastric artery, like other superficial arteries, varies much in size; in some they

are so small that they can be traced for a short distance only, while in others they are large and tortuous, as is often the case in ascites. The superficial epigastric artery must be divided in the operation for the relief of strangulated hernia.

II.

ARTERIÆ PUDICÆ SUPERFICIALES VEL EXTERNÆ,

Are generally two in number, a superior and inferior, they are smaller than the epigastric artery; they arise from the femoral artery, close to the last described branch, and frequently from a short trunk common to both. The superior superficial pudic artery passes upwards and inwards, towards the pubis, and then divides into several long and tortuous branches, some of which pass above, others below the spine of the pubis; they are all distributed to the external parts of generation, and inosculate with the perinæal artery, and with cutaneous branches from the internal pudic.

The inferior of these pudic branches is not always present; it sometimes arises from the superior branch, sometimes from the trunk of the femoral, and sometimes from the internal circumflex; it lies deeper than the superior, its course is in a transverse direction, towards the perinæum, it passes across the pectinæus muscle, and is covered by the fascia lata; the branches of this artery are distributed to the muscles and integuments in the perinæum. The superior of these

pudic branches also is liable to be divided in the operation for strangulated femoral and inguinal hernia.

III.

ARTERIA CIRCUMFLEXA ILII SUPERFICIALIS,

Is smaller than either of the two last branches, close to which it arises; it is covered by the integuments, and runs parallel to Poupart's ligament, as far as the spine of the ilium; it then divides into several branches, which pass in different directions, and communicate with cutaneous branches from the deep circumflex ilii artery, also with superficial twigs from the gluteal and from the external circumflex artery, a branch of the profunda femoris.

IV.

ARTERIA PROFUNDA FEMORIS.

This is an artery of considerable magnitude and importance; it is the principal vessel for supplying the great mass of muscles on the front, as well as those on the internal and posterior part of the thigh.

The arteria profunda arises from the external and rather from the posterior part of the femoral artery; in general, about two inches below Poupart's ligament, sometimes an inch or two lower down, and sometimes much nearer to this ligament; the profunda occasionally appears as large as the continuation of the

femoral, so that this trunk appears to divide into two arteries of nearly equal size.

The arteria profunda first bends outwards, towards the sartorius muscle, so as to appear on the iliac side of the femoral artery; it then turns backwards and inwards, pierces the deep layer of fascia lata, and descends on the inside of the femur, parallel to the femoral artery, but at a considerable distance behind it, and separated from it by the femoral and profunda veins, by a quantity of cellular membrane which contains a number of small veins and arteries, and lastly, by the tendon of the adductor longus.

In this course the profunda artery gives off numerous branches to the muscles, and terminates in a muscular branch a little below the middle of the thigh.

To expose this artery and its branches is a troublesome dissection; it will be facilitated by dividing the femoral artery and vein below the origin of the profunda, and removing them from their situation. In the upper part of the thigh there is a considerable quantity of cellular membrane and numerous veins behind the sheath of these vessels, which must be removed; the different muscles at the inner side of the thigh should be cleanly dissected, and partly separated from each other; the muscles on the posterior part of the thigh also should be exposed, and partly detached from their connexions.

The profunda artery at first lies on the psoas and iliac muscles, it then passes over the cruræus and vastus internus, and descends in front of the insertion of

the pectinæus and adductor brevis, and behind the tendon of the adductor longus muscles, and terminates in a small branch, which passes through the adductor magnus, to the back part of the thigh, is distributed to the hamstring muscles, and ends in numerous inosculations with the perforating branches, and with small arteries from the poplitæal.

The profunda artery, in the first part of its course, that is, while on the iliac side of the femoral artery, is only covered by the fascia and integuments of the thigh; afterwards, as it descends, it is concealed by the femoral artery and vein, to which it runs nearly parallel, but at a much greater depth in the thigh, and lastly, it is covered by the tendon of the adductor longus.

The branches of the profunda artery are numerous and complicated; to make a careful dissection of them requires much time and care. In addition to several small and nameless branches which the profunda artery gives off, there are five or six of considerable size, which have received particular names. The two first are the *external and internal circumflex arteries;* these arteries supply the muscles around the hip-joint, and anastomose with each other, and with several other arteries around this articulation; the three or four remaining branches of the profunda are named the *perforating arteries;* these branches pass through the tendons of the adductors, to the muscles situated on the back part of the thigh.

I.

ARTERIA CIRCUMFLEXA EXTERNA,

Arises from the profunda while this vessel is on the iliac side or behind the femoral artery; it is generally, but not always, its first branch.

The external circumflex artery is a large but short trunk, it soon divides into a great number of branches to supply the muscles on the outer and fore-part of the thigh. This artery runs in a direction outwards towards the sartorius, and passes through the divisions of the anterior crural nerve; it lies in a quantity of loose cellular and adipose substance, between the tensor vaginæ and psoas and iliac muscles, in front of the latter, and behind the sartorius and rectus; its branches may be divided into three sets, ascending, descending, and circular or circumflex. The first, or ascending set, consists of three or four small branches, which pass under the sartorius and tensor vaginæ femoris muscles, and then ascend between this muscle and the glutæus medius and minimus, towards the spine of the ilium; these branches assist in supplying the several muscles in their vicinity, and anastomose with the gluteal arteries, and with small branches of the internal circumflex ilii.

The circumflex branches are seldom more than two or three in number; they pass deeper than those last described, and are covered by the sartorius, tensor, and rectus femoris muscles; these branches pass in

front of the cruræus, and penetrate the vastus externus muscle below the great trochanter; some perforate the tendinous expansion of the glutæus maximus, and arrive at the back part of the thigh, where they anastomose with the internal circumflex, gluteal, and sciatic arteries from above, and with branches from the perforating arteries from below.

The descending branches of the external circumflex artery are five or six in number, they are very long and of considerable size; they descend along the anterior part of the thigh, accompanied by branches of the anterior crural nerve; some of these arteries run in the substance of the rectus, some between the cruræus and vastus internus, and others, the principal, between the cruræus and vastus externus. These branches supply the extensor muscles, and may be traced near to the knee-joint, where they terminate in free inosculations with the external and internal articular arteries, and with small branches from the femoral artery in the vastus internus muscle.

These descending branches are sometimes greatly enlarged in long continued disease of the knee-joint: and in such cases, when amputation of the thigh is to be performed, it will often be necessary to tie several arteries.

The chain of anastomoses between the gluteal, external circumflex and articular arteries around the hip and knee-joints, must be of considerable importance in maintaining the circulation in the lower extremity, in case the femoral or external iliac artery has been obliterated.

The external circumflex artery not unfrequently arises from the femoral, and sometimes instead of proceeding from it or from the profunda, as a distinct trunk, three or four branches arise separately, and take the course of the divisions of the external circumflex artery now described.

II.

ARTERIA CIRCUMFLEXA INTERNA.

This artery in general arises from the profunda, immediately after the external circumflex: its course is backwards and inwards; it supplies the articulation of the hip and the muscles at its internal and posterior part.

The dissection of this artery is rather difficult; the pectinæus, gracilis, adductor brevis and longus muscles must be divided; in doing so care should be taken to avoid injuring the branches which these muscles receive.

The internal circumflex artery passes backwards nearly parallel to the tendon of the psoas, between it and that of the obturator internus, and between the head and lesser trochanter of the femur. It is surrounded by a quantity of loose cellular membrane, and is situated in a sort of cavity of a triangular figure, bounded externally by the capsular ligament, by the neck of the femur, and by the psoas and iliac muscles and tendon; superiorly, by the obturator externus, and internally by the adductor muscles; this space is

covered anteriorly by the pectinæus; and partly closed posteriorly by the adductor magnus and quadratus femoris, between which muscles there is a narrow fissure, through which pass the terminating branches of this artery.

In this course the internal circumflex artery gives off several branches to supply the pectinæus, adductor brevis, and longus muscles; when the pectinæus is divided, a very free inosculation between these branches and the obturator artery is exposed. Several small branches from the internal circumflex artery pass through the upper extremity of the adductor brevis and gracilis muscles, and are distributed to the integuments of the perinæum. In addition to these branches, the internal circumflex artery gives off from its external side a small branch (the *articular artery*,) which passes beneath the ligament, covering the notch at the lower and internal part of the acetabulum; this artery then ramifies in the soft adipose substance in this cavity, and on the ligamentum teres and the synovial membrane of the joint; this articular branch sometimes arises from the obturator artery, and in some subjects, the joint receives branches from both these arteries.

The termination of the internal circumflex artery may be seen on the back part of the thigh; raise the lower edge of the glutæus maximus, draw to one side the sciatic nerve, and then separate the inferior margin of the quadratus femoris from the superior border of the adductor magnus, the internal and circumflex artery will be then seen dividing into two branches, a

superior and inferior: the former ascends and passes outwards along the obturator externus tendon, to the digital cavity behind the great trochanter, where it anastomoses with the gluteal and with the external circumflex arteries. The inferior branch is the larger, it passes backwards, between the quadratus and adductor magnus, and divides into several branches which are distributed to the glutæus maximus, semitendinous, semi-membranosus and adductor magnus muscles, also to the sciatic nerve; these branches communicate with the superior perforating, and with the gluteal and sciatic arteries.

These inosculations between the internal circumflex artery and the branches of the internal iliac, are of considerable importance in establishing collateral circulation, in case the external iliac or the femoral artery has been obliterated.

The internal circumflex artery is a very regular branch, as to its course and termination; its origin, however, varies; it very frequently proceeds from the femoral artery, prior to the origin of the profunda, in which case it arises before the external circumflex artery; when it is derived from the profunda, it is generally, but not always, subsequent to the origin of the external circumflex artery.

As the profunda artery pursues its course along the internal side of the thigh, after giving origin to the circumflex arteries, it continues to send off several branches: from its external side numerous small arteries arise, which pass to the vastus internus and

front of the cruræus, and penetrate the vastus externus muscle below the great trochanter; some perforate the tendinous expansion of the glutæus maximus, and arrive at the back part of the thigh, where they anastomose with the internal circumflex, gluteal, and sciatic arteries from above, and with branches from the perforating arteries from below.

The descending branches of the external circumflex artery are five or six in number, they are very long and of considerable size; they descend along the anterior part of the thigh, accompanied by branches of the anterior crural nerve; some of these arteries run in the substance of the rectus, some between the cruræus and vastus internus, and others, the principal, between the cruræus and vastus externus. These branches supply the extensor muscles, and may be traced near to the knee-joint, where they terminate in free inosculations with the external and internal articular arteries, and with small branches from the femoral artery in the vastus internus muscle.

These descending branches are sometimes greatly enlarged in long continued disease of the knee-joint: and in such cases, when amputation of the thigh is to be performed, it will often be necessary to tie several arteries.

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As the profunda artery pursues its course along the internal side of the thigh, after giving origin to the circumflex arteries, it continues to send off several branches: from its external side numerous small arteries arise, which pass to the vastus internus and

covered anteriorly by the pectinæus; and partly closed posteriorly by the adductor magnus and quadratus femoris, between which muscles there is a narrow fissure, through which pass the terminating branches of this artery.

In this course the internal circumflex artery gives off several branches to supply the pectinæus, adductor brevis, and longus muscles; when the pectinæus is divided, a very free inosculation between these branches and the obturator artery is exposed. Several small branches from the internal circumflex artery pass through the upper extremity of the adductor brevis and gracilis muscles, and are distributed to the integuments of the perinæum. In addition to these branches, the internal circumflex artery gives off from its external side a small branch (the *articular artery*,) which passes beneath the ligament, covering the notch at the lower and internal part of the acetabulum; this artery then ramifies in the soft adipose substance in this cavity, and on the ligamentum teres and the synovial membrane of the joint; this articular branch sometimes arises from the obturator artery, and in some subjects, the joint receives branches from both these arteries.

The termination of the internal circumflex artery may be seen on the back part of the thigh; raise the lower edge of the glutæus maximus, draw to one side the sciatic nerve, and then separate the inferior margin of the quadratus femoris from the superior border of the adductor magnus, the internal and circumflex artery will be then seen dividing into two branches, a

also may be sometimes seen to enter the femur by an oblique canal in the linea aspera. In this course the second perforating artery supplies the adductor muscles also; its branches on the posterior part of the thigh form a complete network of vessels between the different muscles in this region, and numerous branches from it terminate in free inosculations with different arteries, namely, superiorly with the sciatic, glutæal, internal and external circumflex and superior perforating arteries; and inferiorly, by means of very large branches which descend with the inferior branches of the profunda, and with branches of the popliteal artery.

This second perforating artery does not always pass through the tendon of the adductor brevis, it sometimes runs inferior to it.

5. ARTERIA PERFORANS TERTIA, arises from the profunda, at the upper edge of the tendon of the adductor longus, and passing backwards, it perforates the adductor magnus, and is then distributed to the back part of the thigh in a manner similar to the other perforating arteries.

The profunda artery having given off these several branches becomes much diminished in size, and terminates in a small but long branch, which is by some considered as the fourth perforating artery; it passes behind the tendon of the adductor longus, parallel to the femoral artery, perforates the adductor magnus, and descends obliquely outwards along the posterior part of the thigh; it then divides like the other perforating arteries into several branches, which supply the

cruræus; from its posterior part proceed three or four large branches, named the perforating arteries.

3. ARTERIA PERFORANS PRIMA, arises from the profunda, opposite the lesser trochanter; it passes backwards between the tendons of the pectinæus and adductor brevis, (it sometimes runs through an opening in the tendon of the adductor brevis,) it then perforates the adductor magnus close to the linea aspera, and divides into branches. In this course the first perforating artery supplies the pectinæus, adductor brevis and magnus muscles; its terminating branches are distributed to the biceps, vastus externus, and glutæus maximus, and communicate with branches from the glutæal, sciatic and circumflex arteries from above, and with the other perforating arteries from below. This perforating artery is sometimes a branch from the internal circumflex artery; its course is nearly parallel to that vessel, and is separated from it by the tendon of the pectinæus muscle; the first perforating artery passing below that tendon, while the circumflex artery runs superior to it.

4. ARTERIA PERFORANS SECUNDA, is in general a much larger branch than that last described. This artery passes backwards, through a foramen in the tendon of the adductor brevis, it then perforates the adductor magnus, and arriving at the posterior part of the femur, divides into several branches; some of which ascend to the glutæus maximus and vastus externus; others descend, and supply the hamstring muscles and the sciatic nerve; a considerable branch

also may be sometimes seen to enter the femur by an oblique canal in the linea aspera. In this course the second perforating artery supplies the adductor muscles also; its branches on the posterior part of the thigh form a complete network of vessels between the different muscles in this region, and numerous branches from it terminate in free inosculations with different arteries, namely, superiorly with the sciatic, glutæal, internal and external circumflex and superior perforating arteries; and inferiorly, by means of very large branches which descend with the inferior branches of the profunda, and with branches of the popliteal artery.

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hamstring muscles, principally the short head of the biceps, and inosculate with branches of the popliteal from below, and with the perforating arteries from above.

The perforating branches of the profunda maintain a chain of free inosculations on the back part of the thigh from the pelvis to the knee, connecting the branches of the internal iliac artery with those of the femoral and popliteal; these inosculations are found very distinct and free in cases where the external iliac or femoral artery has been obliterated.

The student is not to be surprised if he find the foregoing description of these branches not exactly to accord with their course in every subject. The perforating arteries are very regular as to their existence and destination, but with respect to their origin, number, and relation to muscles, they are very uncertain, and no description can embrace the numerous varieties they present.

The student having concluded the dissection of the profunda, may next examine the other branches which the femoral artery sends off in its course down the thigh; these branches are distributed to the muscles on the inner and fore-part of the limb, and are so irregular in their origin and course, that they have received no distinct names, some are very small, others are of considerable size; the sartorius receives the principal share of these.

When the femoral artery is about to become the popliteal, it gives off the next branch, which is con-

sidered of sufficient importance to receive the following name :—

6. ARTERIA ANASTOMOTICA MAGNA, arises from the femoral artery, as this trunk is about to enter the opening in the tendon of the triceps; it descends to the inner side of the knee-joint. This artery immediately after its origin passes from beneath the edge of that fascia which was before described as covering the femoral artery in the middle third of the thigh: it then descends towards the inner condyle, inclining a little forwards, and soon divides into three or four branches; some of these are distributed to the vastus internus and cruræus muscles, and inosculate with the descending branches of the external circumflex artery; the continuation of the original vessel descends along with the saphenus nerve to the knee, and there anastomoses with the internal articular arteries, and assists in supplying the synovial membrane and the integuments.

The anastomotica magna artery in some subjects is very large at its origin; this, together with the great depth at which it lies from the surface, and its close connexion to the saphenus nerve, have caused it to be mistaken for the femoral artery in the operation of tying this vessel in the middle third of the thigh; particularly where the limb has been injected with blood, the consequence of a punctured wound, and when the natural appearance of the parts has been found so completely changed as that they have been with difficulty recognized.

In amputation of the thigh in this situation, this artery should be secured; for, although it may not bleed at the time of the operation, yet, as its origin from the femoral artery is in general immediately above the situation of the ligature on the trunk, it may be the source of an alarming secondary hæmorrhage. In some subjects this artery is very small, and in many cases instead of one branch, the femoral or popliteal artery gives origin to several branches, which take the course of the divisions of the anastomotica magna.

Before the student should proceed to examine the popliteal artery, he should reflect on what practical inferences may be deduced from a knowledge of the relative anatomy of the femoral artery; he should first consider where this trunk can be most effectually compressed during life in performing amputation of the thigh or leg, or in any operation on the lower extremity in which we are desirous to command the circulation. Immediately below Poupart's ligament this artery is very superficially covered, and rests on the psoas muscle, which is here firmly supported by the acetabulum and the head of the femur; in this situation then the surgeon may with his finger, or with any firm substance, compress the femoral artery, so as to stop the flow of blood through it; it is not, however, in this situation that the tourniquet is ordinarily applied, for the circular strap of this instrument cannot be secured on the thigh higher than the lower edge of the glutæus maximus, or the fold of the nates, and this line is inferior to the acetabulum or to the

head of the femur; hence the tourniquet cannot compress the artery opposite these resisting bodies, but is applied against this vessel where there is no support immediately behind it; it is rather then, by the general circular compression forcing the surrounding parts against the artery, that the caliber of the latter is diminished by the pressure of the instrument; this may explain why in many instances the tourniquet fails to command the circulation perfectly: it may be prudent, therefore, in any case where we are very anxious to prevent any loss of blood, to apply direct pressure on the femoral artery immediately below Poupart's ligament, or on the external iliac vessel immediately above this line, either with the thumb placed transversely, or with the handle of a large key or an office seal padded round with a little lint. In amputation of the leg, the femoral artery may be compressed in the middle third of the thigh; in this case a small compress should be applied beneath the tourniquet over the line of this artery, and the pressure directed outwards, so as to compress the vessel against the femur on the inside of which it lies in this part of the limb.

The femoral artery may require to be tied in case of a wound, or of an aneurism of any of the principal arteries of the leg, of the popliteal artery, or of the femoral itself.

The femoral artery may be exposed and tied in the living subject in any part of its course, as must be the practice in case of a recent wound, or of diffused

aneurism the consequence of such: however, from the dissection which the student has made of this artery, he will perceive that this operation may be much more easily and expeditiously performed in some situations than in others.

The observations which have been made to prove the capability of the anastomosing branches around the hip-joint, to supply the lower extremity with blood, in case the external iliac artery had been obliterated, will equally apply to those cases in which the femoral artery is to become the subject of operation: if this vessel be obliterated above the origin of the profunda, the blood may, by the different anastomosing vessels before mentioned, pass into this artery, and so into the trunk of the femoral; but should the profunda artery be obstructed, or the femoral, below the origin of this great branch, then the blood will pass, not directly into this trunk, but will descend through the long branches of the external circumflex artery on the anterior part of the limb to the articular arteries; and posteriorly, through the different branches of the perforating arteries down to the popliteal artery.

The most frequent cause requiring a ligature on the femoral artery is popliteal aneurism. To Mr. Hunter is justly due the full merit of this improvement in the treatment of this disease; he was the first who proposed to tie the artery at a distance from the aneurismal sac, and he first put this plan into practice on the femoral artery in a case of popliteal aneurism. The femoral artery may be tied in any part of its course;

for the cure of popliteal aneurism, however, one of two situations is generally selected, either the middle third, or the superior third of the thigh; the former situation was that selected by Mr. Hunter, and may be named the inferior operation; the latter is that, which is now generally preferred for several reasons, and may be named the superior operation. I shall first describe the mode of performing both these operations, and shall afterwards contrast them, with the view of considering to which the preference should in general be given.

In the superior operation of tying the femoral artery, our object is to pass a ligature round this artery below the origin of the profunda, and in that part of its course in which it is very superficially covered, that is, between Poupart's ligament and the point at which the sartorius crosses the adductor longus muscle, and as near to this point as possible, that the circulation through the profunda artery may not interrupt the adhesive process at the seat of the ligature: this situation was first recommended by Professor Scarpa. In this operation the patient may be placed in a horizontal posture, the line of the sartorius muscle is to be then observed; this line will be more obvious if the limb be turned somewhat inwards; this expedient, therefore, may in the first instance be resorted to, in order to enable the operator to ascertain the course of this muscle: some authors recommend that the limb should be retained in this position; it appears to me, however, that the future steps of the operation will be facilitated if the limb be turned sufficiently outwards

so as to make this part of the thigh look a little forwards; in this position the artery when exposed will appear to be situated very superficially, whereas if the thigh be rotated inwards, the vessel will appear much more deeply seated. An incision is then to be made through the integuments about two inches and a half long, commencing about two inches below Poupart's ligament, or below the midpoint between the symphisis pubis and the spine of the ilium; this incision is to be continued downwards and inwards in the course of the artery, and along the inner edge of the sartorius; the saphena vein will lie on the internal side of this incision: not unfrequently, however, this vein receives two or three large branches in this part of its course, which come from the anterior part of the thigh; these branches are in danger of being wounded, but may be avoided by cautiously dividing the cellular membrane beneath the integuments. A director should next be insinuated beneath the fascia lata near the lower part of the wound, on which this aponeurosis is to be divided, to the extent of about an inch, the edge of the sartorius muscle will be then exposed; this should be pressed a little outwards. If the finger be now passed into the wound, the pulsation of the vessel will be felt; the artery, however, is not yet sufficiently denuded to admit of a ligature being passed around it, some dense cellular membrane covers it in this situation; this should be carefully divided on the director passed beneath it. A small portion of the sheath of the vessel is then to be elevated in the forceps, and divided by cautious touches of the knife held in a

horizontal direction. The vein is here behind the artery, and is not in general visible; part of it, however, may be sometimes seen on the inner side of the artery; the branches of the anterior crural nerve lie on its iliac side, but frequently one small nerve passes in front of the artery. The artery and vein are next to be separated from each other; this is often attended with some difficulty, owing to the intimate adhesion of their coats; a blunt instrument, however, such as the end of a blunt aneurism needle, or of an eye probe, may be insinuated between them; and should then be directed from within outwards, as the vein will thus be more perfectly secured from injury, and the nerves on the outer side of the artery can be easily avoided. The ligature having been tied, and one end cut close, the wound is to be gently closed by adhesive plaster, and the patient kept at perfect rest, with the limb in the flexed position, so as to avoid any tension on the vessel.

Although in the dead subject this operation may appear simple and easy of execution, yet in the living it is sometimes attended with considerable difficulty: if the patient be fat, or if there be any œdema in the limb, or if the thigh have become fixed in any unfavourable position, this operation may prove extremely difficult and embarrassing. When the coverings of the artery have been divided, the vessel will not in every instance pulsate, and the touch will often be unable to distinguish it from the surrounding parts. Nothing can more tend to render this operation difficult than neglecting to make a sufficiently free divi-

sion of the integuments. Wherever, therefore, we suspect that the coverings of the artery are thicker than usual, we should make the first incision proportionably longer. No attempt should be made to force the aneurism needle around the artery, until the vein and it have been clearly separated; these vessels often adhere so closely, that without due attention to this point, the extremity of the needle may be forced through the vein, and a portion of the latter be included in the ligature, which accident will most probably give rise to a fatal inflammation of the vein.

In the inferior operation of tying the femoral artery, our object is to pass a ligature round this vessel a little below the middle of the thigh, while the artery is covered by the sartorius, and immediately before it perforates the tendon of the triceps; this operation was first performed by Mr. Hunter. In this operation the patient should be placed in the horizontal posture, and the limb rotated outwards, an incision between three and four inches in length is then to be made through the integuments; this incision should commence about the centre of the thigh, and be carried perpendicularly down about an inch or an inch and a half from its internal margin, that is, nearer to the femur than to the internal edge of the thigh; the saphena vein is in danger of being wounded in this operation if the cellular membrane beneath the integuments be incautiously divided; this vein, however, will in general be found to be posterior or internal to the incision that has been now directed. Its situation and course may be previously ascertained by causing

its distention by applying pressure higher up in the thigh. This incision will be nearly parallel to the inner edge of the sartorius muscle, which muscle will be exposed by dividing the fascia lata of the thigh; the inner edge of the sartorius is then to be raised, and drawn gently outwards by a broad curved retractor. The strong fascia which covers the artery in the middle third of the thigh is now exposed, and must be next divided on a director insinuated behind it; unless this fascia be freely divided, it will be impossible to pass a ligature around the artery in this situation; when this aponeurosis has been cut through, the sheath of the vessels will be exposed, it here contains the saphenus nerve with the artery and vein; the nerve lying on the anterior and external part, and the vein behind the artery, the nerve may be drawn outwards with a blunt hook, and the aneurism needle must be cautiously insinuated between the vein and artery, directing it from within outwards.

This operation will be found much more difficult to perform than that last described, the sartorius muscle is sometimes so broad in this situation that its edge is not immediately exposed when the integuments have been divided; the fascia behind this muscle also increases the difficulty, for when the sartorius has been raised, this aponeurosis prevents the operator feeling the pulsation of the artery: and should he proceed to search for it near the inferior part of the incision, he may mistake the arteria anastomotica magna for the trunk of the femoral. In this situation the femoral artery lies at a great depth from the surface, particu-

larly if the natural relations of the parts should be at all altered by disease or by an effusion of blood, as in cases of a wound of the artery; in this inferior operation also the surrounding parts must suffer more or less of violence or displacement; this will probably induce deep-seated inflammation, which may lead to the formation of matter beneath the fascia of the thigh, or beneath the sartorius muscle; this will not only excite great symptomatic fever, but may also tend to induce ulceration in the coats of the artery above the ligature, and so give rise to secondary hæmorrhage. There is no advantage with regard to a greater number of anastomosing vessels being preserved by tying the artery thus low down in the thigh; for on the profunda, after either operation, the principal dependence must be placed for the supply of blood to the limb, when the main artery has been obliterated, and in the superior operation the ligature is applied below the origin of this branch. Against the superior operation it has been urged that the saphena vein is in danger, and that the lymphatic vessels of the lower extremity are liable to be injured. The saphena vein, however, may be avoided, by first ascertaining its course and situation, and experience proves that the fear of injuring the lymphatics is not a well-founded apprehension.

The femoral artery may require to be tied in the inguinal region, near to Poupart's ligament, above the origin of the profunda, in case of a wound or aneurism of the femoral artery or of the profunda, or in the event of secondary hæmorrhage succeeding to the operation first described. To tie the femoral artery

immediately below Poupart's ligament, the patient should be laid in the horizontal position, the limb extended and rotated outwards as much as the circumstances of the case will permit, then commence an incision about an inch above Poupart's ligament, and continue it in the line of the artery to the distance of two inches below this ligament; the layers of the superficial fascia are then to be divided to the same extent: if any considerable arterial branches bleed they should be tied, the lymphatic glands may be pushed to either side; if diseased (as they not unfrequently are in case of aneurism) they will be found to add to the difficulty of the operation, and it may be necessary to remove one or two of them. The fascia lata is next to be divided, and the sheath of the femoral vessels opened in the same manner as before directed; the vein here lies to the pubic side of the artery; around the latter the aneurism needle is to be then directed from within outwards; the anterior crural nerve is not exposed in this operation, as it lies external to, and deeper seated than the artery.

In some subjects the profunda arises very high, and it and the femoral artery will appear of equal size and equally superficial, so that it may be difficult when these vessels are exposed in the living subject to discriminate one from the other: the profunda artery, however, is the most external of the two; by alternately pressing these two vessels, at the same time examining the aneurismal tumour or the bleeding from the wound, we may be enabled to ascertain which is the femoral and which is the profunda, or

which of these two vessels is connected with the disease or wound which has required the operation; and should no particular circumstance forbid, we may include only one artery in the ligature.

Excepting the irregularities already noticed in respect to the origin of the circumflex, and the arrangement of the perforating and other small muscular branches of the profunda and femoral arteries, but few deviations of any importance occur in the course of the femoral itself, or in the place of its division into its two terminating branches. In this respect the blood vessels in the inferior extremity differ materially from those in the superior, in the latter the disposition to variety is frequent, whereas the femoral artery is almost constant in its course and in the place of its division. Cases, however, have occurred, in which, analagous to the high division of the brachial, the femoral artery has been found to have been divided into the tibial and fibular arteries so high as the groin: in some cases too of high division of the femoral artery, the branches have united before their arrival at the poplitæal space; this arrangement, which has its frequent parallel in the upper extremity, is important to recollect, as it might lead to an unsuccessful result to the operation of tying the femoral artery for the cure of poplitæal aneurism.

ARTERIA POPLITEA.

The continued trunk of the femoral having passed through the opening in the triceps, receives the name of popliteal artery, and takes an oblique course downwards and outwards to the lower edge of the poplitæus muscle, where it divides into the anterior and posterior tibial arteries; through this extent the artery lies in the popliteal space, to the anatomy of which region the student should now direct his attention.

The subject being laid on the face, the integuments should be removed from the inferior third of the thigh and superior third of the leg, a small vein (the posterior saphena) is generally exposed at the inferior part of this dissection; this vein ascends from the back part of the leg and joins the popliteal vein, it is generally accompanied by a small nerve, (communicans tibialis:) the fascia lata must be next removed to the same extent as the integuments; this aponeurosis is very tense in this region, being strengthened by strong transverse bands which serve to bind together the lateral boundaries of this space. The popliteal space occupies about the inferior third of the thigh, and the superior fifth of the leg: it is bounded internally by the semi-membranosus, semi-tendinosus, and internal head of the gastrocnemius muscles; externally by the biceps, plantaris, external head of the gastrocnemius and solæus muscles; it terminates above

and below in a point or angle, so that the whole region is somewhat of an oval or diamond figure.

The popliteal space contains a considerable quantity of adipose substance, also the posterior crural nerve, and the popliteal artery and vein; the nerve is most superficial, and rather to the external side of the mesial line; about the upper part of the popliteal space this nerve usually divides into two branches, the posterior tibial and the peroneal; the latter takes the direction of the biceps tendon, the former descends nearly in the middle line. If the fat which is beneath the nerve be now removed, the popliteal vessels will be exposed; the vein is most superficial, and a little to the outer side of the artery, the latter is nearer to the bone, from which it is separated by some fat, and sometimes by a lymphatic gland. The popliteal artery may now be seen to take an oblique course downwards and outwards, it lies to the inner side of the popliteal space above, but below it is nearly in the centre.

In this course the popliteal artery is covered superiorly by the semi-membranosus muscle, in the middle by the integuments, fascia, adipose substance, and by the popliteal vein; inferiorly it is overlapped by the heads of the gastrocnemii muscles, and crossed by the posterior tibial nerve. In the superior part of this region the artery lies on the posterior surface of the femur; in the middle, on the posterior ligament of the knee-joint; and inferiorly, on the poplitæus muscle: the popliteal vein is intimately attached to the artery through the entire course, and lies superficial and

somewhat external to it; the sciatic nerve is still more superficial and more external to it in the upper part of this region, but inferiorly the posterior tibial nerve lies to the inner or tibial side of the artery; a great number of muscular branches of this nerve however lie around the artery, and are so closely connected to it, as to account for the numbness, impaired muscular power, and sometimes pain, which attend an aneurismal tumour in this region.

Above the flexure of the knee-joint there are generally three or four lymphatic glands imbedded in the adipose substance around the artery; one of these is placed on either side of the artery, one usually lies superficial to this vessel, and sometimes one is situated between it and the bone: if these glands become inflamed and suppurate, or if they remain enlarged and indurated, the tumour which they form may have the pulsation of this artery communicated to it, and so resemble an aneurism: in some instances, particularly if the disease have been of long duration, it will require a careful examination to discriminate between them. This examination will be much facilitated if the different muscles which bound this region be put into a relaxed position; we can then insinuate our finger into the popliteal space, so as to ascertain the exact situation or attachment of the tumour, also its mobility and how far pressure can alter its size. By directing an assistant alternately to compress and to leave free the femoral artery, we may judge whether any change occurs in the form of the tumour, or whether its size or tension undergoes any alteration or increase.

The popliteal artery gives off a great number of branches, they are all small and of little practical importance except in assisting to establish collateral circulation in case the femoral or popliteal artery has been obliterated. It first sends off several muscular branches to supply the muscles on the back part of the thigh; it next gives off the *articular* arteries; these supply the knee-joint, are five in number, and are distinguished by the names of 1. *superior internal*, 2. *superior external*, 3. *azyga*, 4. *inferior external*, *and* 5. *inferior internal;* lastly, the popliteal artery gives off several muscular branches to the heads of the gastrocnemii and solæi muscles.

1. RAMI MUSCULARES SUPERIORES, are two or three in number; they are distributed to the biceps, semi-tendinosus, and semi-membranosus muscles, some perforate the biceps and enter the vastus externus, others anastomose with the branches of the perforating arteries.

2. ARTERIA ARTICULARIS SUPERIOR EXTERNA, arises from the outer side of the popliteal artery, and passes upwards and outwards above the external condyle of the femur, and beneath the tendon of the biceps; this artery then turns round to the anterior part of the femur, and divides into a superficial and deep branch; in this course it supplies the external head of the gastrocnemius, the biceps and vastus externus muscles. The superficial branch then runs through the vastus externus to the patella, and ramifies on this bone; the deep branch supplies the synovial membrane, and sends several branches into the substance of the

femur, just where the cartilage commences. Several branches of this artery inosculate with the inferior external articular artery below, and with branches of the external circumflex above.

3. ARTERIA ARTICULARIS SUPERIOR INTERNA, arises from the inner side of the popliteal artery, and above the internal condyle of the femur; it runs close to the bone, and behind the tendon of the vastus internus and adductor magnus muscles; it then divides into superficial and deep branches, the former pass through the vastus internus to the patella, and anastomose with the anastomotica magna and with the external articular artery; the deep branch supplies the synovial membrane and the substance of the bone.

4. ARTERIA ARTICULARIS MEDIA VEL AZYGA, arises from the anterior part of the popliteal artery, opposite the bend of the knee-joint; it then passes through the ligamentum posticum, and divides into several branches, which supply the synovial membrane, the crucial ligaments, and the adipose substance at the back part of the joint.

5. ARTERIA ARTICULARIS INFERIOR EXTERNA, arises from the popliteal artery below, or rather opposite the angle of the knee-joint; this artery passes outwards, and is covered by the plantaris, and by the the external head of the gastrocnemius muscle, also by the external lateral ligament; it turns round the outer side of the joint, above the head of the fibula, along the external semilunar cartilage, as far as the patella; in this course it supplies the joint and the different muscles it passes by; its branches anastomose with

the other articular arteries, and with the anterior tibial recurrent.

6. ARTERIA ARTICULARIS INFERIOR INTERNA, arises from the inner side of the popliteal artery, inferior to the last described branch; this artery runs downwards and inwards below the internal condyle of the tibia, and then turns round to the anterior surface of this bone, passing behind the internal lateral ligament and the tendons of the flexor muscles: this artery then divides into several branches, which supply the head of the tibia, the ligamentum patellæ, and the subjacent adipose substance.

7. RAMI MUSCULARES INFERIORES, arise from the popliteal artery below the joint; they are three or four in number, they sometimes arise separately, and sometimes by one or two common trunks, which soon subdivide into several branches: these descend obliquely, and enter the gastrocnemii muscles; these branches can be traced along the anterior surface of these muscles a considerable way, even to the common tendon of the gastrocnemii and solæi; some long branches of these arteries also descend in the integuments on the back part of the leg, as far as the heel.

Before the student proceeds to dissect the branches into which the popliteal artery divides, and which supply the leg, he should reflect on what practical deductions may be drawn from considering the situation and connexions of this trunk. Although this artery lies very deep in the popliteal region, yet it may become the subject of operation.

The popliteal artery may require to be tied in case

of a wound of it or of the posterior tibial artery, or of aneurism of this latter vessel, situated high in the leg. The student should consider the distance of the popliteal artery from the surface in different parts of this space, and in different subjects. In the dead subject this artery may be exposed without much difficulty, either in the superior or inferior part of its course; but, about the middle of the popliteal space it is extremely difficult to do so.

In order to pass a ligature around the popliteal artery in the upper part of its course in the living subject, the patient may be placed either in the horizontal position on his back, with the thigh laid on its outer side and the leg bent, or he may be laid on his face and the limb extended; in either position an incision of about three inches should be made through the integuments, along the posterior or external margin of the semi-membranosus muscle, the fascia lata is to be divided to the same extent, and then by raising or drawing inwards the edge of the semi-membranosus, the finger will directly feel the pulsation of this artery. The posterior crural nerve is in this situation so far to the outer or fibular side, that it is not endangered in the operation; the vein is to be cautiously separated from the artery, and pressed to the outer side, the aneurism needle may then be insinuated between it and the artery, and carried round the latter from without inwards. On the dead subject this operation is not attended with much difficulty, and appears nearly as practicable as the Hunterian operation

on the femoral artery, but neither can be compared with the high operation as advised by Scarpa.

If we attempt to expose this artery in the middle division of the popliteal space, we shall find considerable difficulty; the vessel here lies so deep, and the sides of this space are so tense, as to render it very difficult to separate them from each other, particularly if the limb be extended; and if we bend the leg, that the muscles may become relaxed, we shall impede our view of the deep-seated parts.

In order to pass a ligature around the artery as it lies between the heads of the gastrocnemii, the patient should be laid on his face, and the limb extended: the situation of the artery may be ascertained by feeling its pulsation; an incision about three inches long should then be made parallel to the middle line, commencing opposite the bend of the knee-joint; when the integuments and fascia have been divided, the posterior saphena vein and its accompanying nerve will be exposed; these should be carefully drawn to either side, and then by separating some dense cellular membrane, the popliteal artery and vein and the posterior tibial nerve, will be brought into view as they are descending between the heads of the gastrocmii muscles. Some of the inferior muscular branches of the popliteal artery will in all probability be divided in this part of the operation; they should be immediately secured. If an assistant now flex the leg a little, and press to either side the heads of the gastrocnemii muscles, the surgeon will be able to separate the artery from the surrounding parts; the posterior

tibial nerve should be drawn inwards and the vein outwards, the aneurism needle may then be insinuated between the vein and artery, and carried round the latter from without inwards, taking care to avoid including the nerve in the ligature. Although I have thus considered the best mode of exposing this artery in different situations in this region, yet, I conceive, that such an operation can never be required in any case except of recent wound, in which, as I have often remarked before, the surgeon is to be guided by the extent and direction of the injury, as much as by his anatomical knowledge; in aneurism in this region no surgeon now thinks of opening the popliteal space.

In the living subject, if we flex the leg, we can feel the pulsation of this artery near the middle of the popliteal space: in case of amputation of the leg or foot, this artery may be compressed by the tourniquet in this situation; the compress should be so small as to admit of being insinuated between the hamstring muscles, and should be pressed a little inwards: compression thus applied is sometimes attended with a greater degree of pain than the patient can endure, and it is seldom as effectual as if applied on the femoral artery.

In cases of obliteration of the poplitæal artery and of the continued femoral, the usual result of the operation for the cure of poplitæal aneurism, the articular and muscular branches of the poplitæal become much increased in size, and through their free communications with the muscular arteries in the thigh, as also

with those in the leg, the circulation through the latter is in some time freely established.

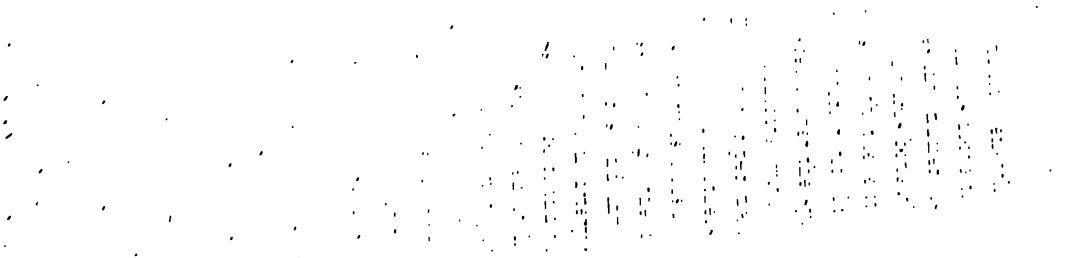
The student may now proceed with the dissection of the arteries of the leg: the subject may be placed in the same position as was recommended in the dissection of the popliteal artery; the gastrocnemii muscles should be divided a little below their origin, and by removing some dense cellular membrane and several veins, the popliteal artery will be seen dividing into its two branches a little above the lower edge of the poplitæus and the superior fibres of the solæus muscles. The posterior tibial artery is the larger of the two, and appears, from its direction, as the continuation of the popliteal. This is the usual place of division, it sometimes, however, occurs higher in the poplitæal space: I have seen it in one instance take place between the condyles of the femur, in which case the two arteries proceeded close together to the usual place of separation, and the anterior tibial gave off the inferior external articular artery: in some cases the anterior tibial is so small, that the poplitæal can scarcely be said to divide, but is rather continued on as the posterior tibial, which in its course down the leg will give off branches corresponding to, and answering the purposes of the anterior tibial and peronæal arteries.

ARTERIA TIBIALIS POSTICA.

THIS is an artery of considerable size, it extends from the edge of the poplitæus muscle to the fossa between the inner ankle and the heel, where it divides into the internal and external plantar arteries, which supply the muscles and integuments of the sole of the foot and toes.

To expose this artery, the student may detach the internal head of the solæus from the tibia, and turn it, together with the gastrocnemii towards the fibula; or these superficial muscles may be cut across, and not separated from the bone: beneath these muscles we find a very strong fascia, covering the posterior tibial nerve and vessels, and binding down the deep-seated muscles, this fascia is partly continuous with that which is derived from the poplitæus and from the tendon of the semi-membranosus muscle. Near the centre of the upper extremity of the solæus is a well defined semilunar opening, whose tense and tendinous border defends the vessels in their passage through it, from the superincumbent muscles.

The posterior tibial artery descends in an oblique direction from the middle of the leg to the centre of the fossa between the heel and inner ankle; about the middle of the leg it is half an inch from the edge of the tibia. This artery in this course is accompanied by two veins, one on either side, also by the posterior tibial nerve; in the upper part of the leg this nerve lies to the inner or tibial side of the artery, it soon, however, passes over it; and inferiorly it lies to its outer or fibular side.



the fibula, beneath the peronæus tertius muscle, about two inches above the malleolus externus; it then divides into numerous branches which pass downwards and inwards beneath the extensor tendons, and anastomose with the external malleolar artery, a branch of the anterior tibial; from this anastomosis branches descend over the synovial membrane of the joint, and communicate with different arteries on the tarsus. The anterior peronæal artery in some instances is very small, while in others it is of considerable size: when this artery is unusually large, we find that when it has passed through the interosseous ligament, it inclines downwards and inwards, and joins the trunk of the anterior tibial artery; in such cases this last named vessel will be found very small, and will appear almost exhausted when it has arrived near the ankle, and then the anterior peronæal will take its place, and supply its deficiency.

2. ARTERIA PERONÆA POSTERIOR, appears as the continuation of the fibular artery in direction and in size; it descends behind the inferior extremity of the fibula, to the external side of the os calcis. In this course the posterior fibular artery gives off several branches to the flexor communis, flexor pollicis, and peronæus longus and brevis, it also sends branches to the back part of the ankle-joint, and one or two branches take a transverse course inwards towards the tibia, and join the posterior tibial artery.

This artery is accompanied by the communicans tibialis nerve around the external malleolar region, the nerve lying superficial; when the artery has arrived at the external side of the os calcis, it divides into

numerous branches, some of which are distributed to the adipose substance about the heel, and anastomose with the posterior tibial artery; others pass on to the sole of the foot, and inosculate with the external plantar artery; and some turn over the outer margin of the foot, and communicate with the tarsal branches of the anterior tibial artery.

The trunk of the peronæal artery is often absent, its place being then supplied by branches from the posterior tibial artery: on the other hand it is sometimes very large, and at the lower part of the leg will supply the place of the latter.

The student may now examine the remaining branches of the posterior tibial artery. In its course down the leg the posterior tibial artery gives one or two large branches which enter the tibia by a canal, which commences above its centre, and leads obliquely downwards into the substance of the bone; it also sends numerous branches to the muscles, both deep and superficial; these branches have received no particular names; many of them communicate with the peronæal artery, and several long branches pass to the integuments on the posterior and internal part of the leg, some of which unite with branches of the anterior tibial artery. Near the os calcis several branches of considerable size are distributed to the fat behind the tendo Achillis and about the heel, these branches communicate with the peronæal artery; several also run to the muscles in the sole of the foot, and some turn upwards and forwards, ramify on the malleolus internus, and anastomose with the anterior tibial artery.

Previous to examining the arteries in the sole of the foot, the student should re-consider the relative anatomy of the posterior tibial artery in its course down the leg. This artery is exposed to accidents, and at the same time favourably circumstanced for operation only in the inferior third of its course, being covered in the two upper thirds by the internal gastrocnemius and solæus muscles.

The posterior tibial artery may require to be tied in case of a wound in the sole of the foot, which has divided some large artery in that region; also in case of a wound behind the internal ankle, in which the posterior tibial artery itself has been injured, or in case of aneurism in consequence of this wound. When aneurism of the posterior tibial artery is seated high up in the leg, it will be necessary to tie either the popliteal or femoral artery. In case of wounds in the sole of the foot, in which we require to tie the posterior tibial artery, the most favourable situation is between the malleolus internus and the heel: to expose the artery in this situation in the living subject, we should make a semilunar incision of two inches and a half in length through the integuments, commencing near the tendo Achillis, and continuing it downwards and forwards nearly midway between the heel and ankle, a little nearer to the latter. The integuments being divided the fascia of the leg is exposed, which must be cut to the same extent; a little cellular membrane must be now removed, and a very strong aponeurosis is exposed; this is the continuation of the fascia covering the deep muscles of the leg; in this situation it is very tense, it adheres to the sheaths of

the tendons, and covers the vessels and nerves in this region; this fascia must be cautiously divided, and the sheath of the vessels will be exposed; this being opened, the venæ comites are to be separated from the artery, and the aneurism needle carefully passed round the latter, directing it from the heel towards the ankle to avoid the nerve, which in this situation is sometimes very large, and close to the artery.

If the posterior tibial artery be itself wounded in this situation, it may be exposed either at the wound or higher up, in the inferior third of the leg, by making an incision of about two inches and a half long at the inner side of, and parallel to, the tendo Achillis; the two layers of fascia of the leg are to be divided, and the remainder of the operation conducted in the same manner as in that last described.

In case of secondary hæmorrhage after this operation, or in case of aneurism of the posterior tibial artery forming in consequence of a wound of the artery in this situation, it may be necessary either to tie this vessel higher up in the leg, or to tie the popliteal or femoral artery itself; it has been deemed prudent to give the patient the chance of success from the former operation before having recourse to so severe and hazardous a measure as that of tying the femoral or popliteal artery.

This operation of tying the posterior tibial artery in the middle of the leg will be found much more difficult than either of those described, as this vessel here lies at such a depth from the surface, and is covered by the gastrocnemius and internal head of the solæus,

which in this situation is attached to the tibia. To expose the artery here then, the leg should be bent, the foot extended, and both placed on the outer side; make an incision about four inches in length along the inner edge of the tibia, through the integuments and fascia, (the internal saphena vein should be avoided,) the edge of the gastrocnemius muscle will be exposed, this may be easily raised and drawn to the outer side; a director must then be insinuated beneath the inner head of the solæus, on which this muscle must be divided from its attachment to the tibia: the deep fascia of the leg is here very tense and strong, binding down the deep-seated muscles and the tibial nerve and vessels; this must be cautiously divided on the director passed beneath it. The foot should now be extended as much as possible, and the knee placed in the flexed position, to relax the superficial muscles on the back part of the leg; the artery may be now felt pulsating about an inch from the edge of the tibia; the veins are then to be separated from the artery with a blunt instrument, and the aneurism needle passed round the latter in a direction from without inwards, so as to avoid the posterior tibial nerve.

On the dead subject this operation is not attended with much difficulty; in the living, however, the case is very different, the muscles are then rigid and unyielding, and when the fascia which covers them is divided they leave their natural situation and become much elevated, so as to make the situation of the artery appear as a deep cavity, at the bottom of which the vessel is placed.

The first case in which I saw this operation performed was by Mr. Travers in St. Thomas's hospital, on a man who had been wounded by a small chisel a little above the ankle; the artery had been tied at the wound, but secondary hæmorrhage ensuing, it was considered necessary to tie the artery in the middle of the leg: the man was very robust and muscular, and there was considerable difficulty in exposing this vessel; the operation, however, ultimately proved successful. I have known three other cases of this operation, each of which, though attended with considerable difficulty, ultimately proved successful.

It may be requisite to tie this artery in cases of wounds also in this situation, which have penetrated the muscles; in such a case the extent and direction of the wound must guide the surgeon in the several steps of the operation; it will not of course then be necessary to perform the same dissection, or to separate the solæus from the tibia, as recommended in the foregoing page, but merely to enlarge the wound and to divide any muscular fibres that may obscure the bleeding vessel. In case of aneurism, however, or of secondary hæmorrhage requiring the artery to be secured in the middle of the leg, I should prefer exposing it in the way before mentioned, than by cutting down through the muscles of the leg in the direction of the vessel, as recommended by some, particularly Mr. Guthrie, who describes the mode of performing this operation as follows: "the first incision six inches, should be made nearer to the inner edge of the leg, than to the centre, and should be

carried through the gastrocnemius muscle, plantaris tendon and solæus muscle, down to the fascia, under which the artery lies with its accompanying veins, having the posterior tibial nerve to the fibular side. If the incision have been made in the upper part of the calf of the leg, the peronæal artery will be exposed by it: but if the peronæal artery be the vessel injured, the incision should be made towards the fibular side of the leg: and when the surgeon divides the fascia, he will find the artery covered by the fleshy fibres of the flexor pollicis longus muscle, at any distance below three inches and a half from the head of the fibula: and which fibres must be divided, when the artery will be found close to the inside of the bone. Above that part the artery is under the fascia, and upon the tibialis posticus muscle. It has not an accompanying nerve. Both arteries will be readily found, by either of the incisions described, if the surgeon is acquainted with their situation."

As I have before remarked, in cases of wounds in the calf of the leg, particularly gunshot, attended with hæmorrhage, it will be advisable to enlarge the wound in the proper direction, and cut through the muscles, &c., so as to expose the bleeding vessels, the foregoing directions, therefore, will not apply or prove of much service in such cases; but should the operation of tying the posterior tibial artery be required for aneurism or secondary hæmorrhage, the consequence of an injury lower down, I should still much prefer the operation I have first described to that recommended by Mr. Guthrie, the advantages of which in any point of

view I cannot discern or appreciate: as to the peronæal artery, I have not known the operation of tying it in the upper part of the leg to have ever been required except in case of recent wound.

The student may now proceed to trace the internal and external plantar arteries, the divisions of the posterior tibial.

The foot being placed in a convenient situation, remove the integuments from its inferior surface and from the toes; in this dissection numerous small arteries must be divided, particularly about the heel; these branches supply the integuments and subjacent adipose substance, which is very abundant in this situation; it is also very vascular, and presents a peculiar granulated appearance; this substance is closely attached to the plantar aponeurosis, to the structure and attachments of which the student should next attend. The plantar fascia is very strong and tendinous; it extends from the os calcis and from the depressions on each side of this bone, forwards to the toes, and opposite the first phalanx of each, it divides into two fasciculi of fibres, which are inserted into the sheaths of the flexor tendons, and into the sides of the capsular ligaments connecting the metatarsal bones to the first phalanges. This aponeurosis is much stronger posteriorly, particularly in the centre, than anteriorly. Opposite the phalanges of the toes, where this aponeurosis is separating into different fasciculi, we may observe strong bands of fibres crossing these in a transverse direction. The student may now raise this aponeurosis and dissect the superficial layer of

muscles, namely, the flexor digitorum brevis in the centre, the abductor pollicis internally, and abductor minimi digiti externally: these muscles he may either raise from their origin and turn towards the toes, or merely divide a sufficient number of their fibres to expose the deeper-seated parts.

Between the origins of the abductor pollicis muscle, the posterior tibial artery divides into the internal and external plantar arteries; the former is the smaller of the two, and runs a more superficial course.

ARTERIA PLANTARIS INTERNA.

This artery runs along the inferior and internal side of the tarsus, above the abductor pollicis muscle, as far as the first phalanx of the great toe, where it divides into two or three branches, which supply the integuments of this toe. In this course the internal plantar artery sends many branches to the abductor and flexor pollicis brevis, to the articulations of the tarsus, and to the integuments; several branches also turn over the side of the foot, and anastomose on the tarsus and metatarsus with branches from the anterior tibial artery; near its termination it often inosculates with the external plantar artery, so as to form a *superficial plantar arch* of arteries.

ARTERIA PLANTARIS EXTERNA,

Is much larger than the internal plantar, and appears the continued trunk of the posterior tibial. The external plantar artery pursues a tortuous course across the foot, first running downwards and outwards, as far

as the metatarsal bone of the little toe, and then turning in a transverse direction inwards and upwards, to the cleft between the metatarsal bones of the great and second toe, where it terminates in a free inosculation with the anterior tibial artery. This course which the external plantar artery takes, is denominated the *great plantar arch* of arteries. The external plantar artery from its origin to the metatarsal bone of the fifth toe is covered first by the abductor pollicis, and next by the flexor digitorum brevis; it lies inferior to the flexor tendons and to the accessory muscle; from the base of the metatarsal bone the artery runs forwards for a short distance, between the flexor digitorum brevis and abductor minimi digiti; the artery in this straight part of its course lies very superficial in children, and is frequently wounded, being here only covered by the integuments and plantar fascia. As the plantar artery bends across the metatarsal bones, it passes very deep among the muscles of this region, and in this part of its course it is covered by the tendons of the flexor digitorum longus and brevis, and by the lumbricales, and lies between the abductor pollicis and transversalis pedis; having arrived at the base of the metatarsal bone of the great toe, it is joined by the anterior tibial artery, and thus the plantar arch of arteries is formed; this arch extends from the base of the metatarsal bone of the little toe, to that of the great toe; the concavity of this arch looks backwards and inwards, the convexity forwards and outwards.

The external plantar artery, between its origin and the commencement of the plantar arch, sends nume-

rous branches to the different muscles in the sole of the foot; many of these must be divided in exposing the trunk of the artery; these muscular branches are of considerable size, particularly those near the os calcis, several of which pass to the integuments: these arteries anastomose with each other, and with branches of the posterior peronæal and internal plantar arteries.

From the plantar arch several arteries arise; from its concavity many small branches proceed to the muscles and integuments of the sole of the foot; from its superior surface three or four branches arise, and are named *perforating arteries;* they supply the interossei muscles and anastomose with the metatarsal branches of the anterior tibial artery. From the convexity of the plantar arch four long branches proceed, named the *digital arteries.*

The *first digital artery* arises opposite the metatarsal bone of the little toe, and proceeds along its fibular side, beneath its abductor and short flexor muscles, to its last phalanx, where it turns towards the centre and meets a corresponding branch from the next artery.

The *second digital artery* arises a few lines internal to the last, and runs along the interossei muscles to the cleft between the fifth and fourth toes; it here receives a small branch of the metatarsal artery from the interosseous space, and then divides into two long branches which proceed along the opposed sides of these toes to their last phalanges, where they terminate in a manner similar to that first described.

The *third digital artery* arises at a little distance beyond the last, and runs to the cleft between the fourth and third toes, where it divides into two long branches, which run in a manner similar to the former.

The *fourth digital artery* arises internal to that last described, and running to the cleft between the third and second toes, divides into two branches, which have a similar course and termination to those last described.

. The external plantar artery having arrived at the cleft between the metatarsal bones of the second and first toes, receives the communicating branch from the anterior tibial artery, and thus completes the plantar arch of arteries. All the digital arteries of the toes run in a manner similar to those of the fingers, on the inferior and lateral surface of the phalanges; they are accompanied by the digital nerves, these twine around the arteries, and run with them to the last phalanges; the arteries here increase in size, and those of opposite sides unite with each other in the manner of an arch; these arteries in this course supply the integuments of the toes, the flexor tendons and their sheaths, and from their ultimate anastomosis on the last phalanx numerous branches proceed to the integuments and cellular tissue at the extremity of each toe. The great toe and the internal side of the toe next it, are supplied with blood from the anterior tibial artery; the external side of the second, and both sides of the other toes, are supplied by the external plantar arteries.

From the peculiar structure of the integuments and aponeurosis of the foot, superficial wounds in this situation frequently bleed very smartly; there is often great difficulty in exposing the bleeding vessel, so as to apply a ligature around it; and if we enlarge the wound with a view of facilitating this object, we only increase the difficulty, for we shall probably open several other vessels, which may bleed as much as that originally wounded. In such a case, if compression carefully applied fail to stop the hæmorrhage, it will be necessary to tie the trunk of the posterior tibial artery as this vessel is passing through the fossa between the heel and the internal ankle. If, however, the external plantar artery be wounded opposite the base of the little toe, it may be more fully exposed by enlarging the wound, as it is very superficial in this situation: both ends of the opened vessel must be tied in consequence of the proximity of the inosculation with the pedial or the anterior tibial artery.

ARTERIA TIBIALIS ANTICA.

FROM the division of the popliteal artery, the anterior tibial immediately passes forwards between the fibres of the tibialis posticus muscle, and close to the neck of the fibula, through the interosseous space above the interosseous ligament, and below the head of the tibia; it then descends on the anterior surface of the interosseous ligament and of the tibia, passes over the ankle-joint, and then runs forwards on the superior surface of the tarsus to the cleft between the first and second metatarsal bones, where it divides into its two last branches. To trace this artery throughout this course the limb should be placed upon its posterior surface; remove the integuments from the anterior surface of the leg and foot, and divide the fascia of the leg so as to expose the extensor muscles; then commence at the upper part of the leg to separate the tibialis anticus from the extensor digitorum communis, and the artery with its two venæ comites will be brought into view, lying at first on a few fibres of the tibialis posticus, and afterwards on the interosseous ligament near the neck of the fibula; with very little dissection this vessel may now be traced through the remainder of its course.

A line drawn from the head of the fibula to the base of the great toe will be parallel to the course of this artery. In the superior third of the leg the anterior tibial artery lies between the tibialis anticus and ex-

tensor digitorum communis muscles, in the middle third it is between the tibialis anticus and extensor pollicis longus; in these two divisions of the leg it rests on the interosseous ligament and is covered by the muscles which lie on either side. In the inferior third the artery advances a little forwards, and lies on the tibia between the tendons of the extensor digitorum communis and extensor pollicis proprius, the latter overlaps the artery: in this part of its course it is covered only by the integuments and fascia of the leg; in the living subject, however, it is by no means so superficial in this situation as might be supposed from examining it in the dead subject, for the tendons on either side bear off the integuments from the vessel to such a distance, that if these be divided, the artery will appear much deeper-seated than it does in a dissected limb, or in a dry preparation.

The anterior tibial artery having arrived at the inferior end of the tibia, passes anterior to the synovial membrane, and behind the annular ligament of the ankle-joint, it then runs over the astragalus, navicular, and internal cuneiform bones, to the base of the metatarsal bone of the great toe; in this part of its course it is only covered by the integuments, and about the middle of the tarsus it is crossed by the internal tendon of the flexor digitorum brevis.

The anterior tibial artery is accompanied by two veins, one on either side, and by a small nerve, a branch of the fibular or peronæal; this nerve attaches itself to the artery above the middle of the leg, and accompanies it to its termination; the nerve lies su-

perficial to the artery, but it frequently changes its situation from one side to another. Between the first and second metatarsal bones the anterior tibial artery sinks into the interosseous space and divides into two branches.

The anterior tibial artery throughout its whole course gives off several branches; as it is passing between the tibia and fibula it sends several small arteries to the tibialis posticus muscle; having passed through the interosseous space it gives off the recurrent artery; as it descends on the interosseous ligament it sends numerous branches to the muscles on either side: near the ankle it gives off the malleolar arteries, one to either side; as it passes over the tarsus and metatarsus it sends a branch to the bones composing each of these regions, and at the cleft between the metatarsal bones of the first and second toes, it divides into two branches, one of which descending to the sole of the foot, joins the external plantar artery, and is named ramus communicans, the other runs forwards to supply both sides of the first and the internal side of the second toe.

1. Arteria recurrens, arises from the anterior tibial artery as soon as this vessel has passed through the interosseous space; it then bends upwards through the fibres of the tibialis anticus and peronæus longus muscles, pierces the aponeurosis of the leg, and spreads out into numerous branches on the anterior and external surface of the head of the tibia; several branches pass to the adipose substance behind the ligamentum patellæ, others ascend along the fibular margin of this

ligament and anastomose with the inferior external articular artery.

2. RAMI MUSCULARES are very numerous; they arise from either side of the anterior tibial artery, close to one another, and are distributed to the muscles on each side; some of these branches pierce the aponeurosis of the leg, and are distributed to the integuments; others pass through the interosseous ligament, and anastomose with the posterior tibial and peronæal arteries.

3. ARTERIA MALLEOLARIS INTERNA, arises about two inches, sometimes less, above the ankle-joint, it passes behind the tendon of the tibialis anticus, and spreads its branches over the internal malleolus; some of these anastomose with small branches of the posterior tibial artery; others enter the bone, and some descend to the synovial membrane.

4. ARTERIA MALLEOLARIS EXTERNA, arises in general opposite the last described artery, and runs towards the external ankle close to the bone; this artery in general anastomoses with the anterior peronæal, which comes through the interosseous space a little above the ankle. The external malleolar sends several branches to the inferior extremity of the tibia and fibula, and to their connecting ligaments. This artery terminates on the external malleolus by dividing into several branches, some of which communicate with the posterior peronæal artery, and others descend along the outer part of the tarsus, and are lost in the integuments and muscles in that situation. The malleolar arteries are uncertain as to size, and even as to existence.

As the anterior tibial artery is passing over the ankle-joint, it gives off several branches to the synovial membrane and to the surrounding cellular tissue. The remainder of the anterior tibial artery is called by some writers the *pedial artery*.

5. ARTERIA TARSI, arises from the anterior tibial artery as that vessel is passing over the os naviculare; the tarsal artery then runs transversely outwards, distributing its branches to the extensor digitorum brevis, to the different bones of the tarsus, and to the synovial membranes which connect them to each other; at the fibular side of the tarsus it turns beneath the tendon of the peronæus brevis and terminates in the muscles of the little toe, and in inosculations with the plantar arteries.

6. ARTERIA METATARSI, arises from the anterior tibial artery a little beyond the last described branch; it passes outwards over the heads of the metatarsal bones, supplying their articulations; from the anterior part of the arch, which this artery forms, three or four long branches proceed along the three external interosseous spaces; these arteries supply the interosseous muscles, and communicate with the perforating and with the digital branches of the external plantar artery. Previous to the anterior tibial artery dividing into its terminating branches in the first interosseous space, it sends one or two long branches to the upper surface of the great toe; these supply the integuments and extensor tendons of this toe, and run along either side of it to the last phalanx.

7. RAMUS COMMUNICANS. From the division of

the anterior tibial artery this short branch passes directly through the interosseous space, and joins the terminating branch of the external plantar artery.

8. ARTERIA POLLICIS passes forwards to the cleft between the first and second toes, and divides into two branches, one of which passes inwards between the tendon of the flexor pollicis and the bone, and then runs along the internal side of the great toe, to its last phalanx; the other branch subdivides into two arteries to supply the opposed sides of the first and second toes.

The anterior tibial artery is liable to be wounded on the instep, or a little above the ankle-joint; in either of these situations it may be exposed and tied in the living subject; this artery may also require to be tied in the leg in case of wound or aneurism. To tie this vessel above the ankle-joint we should flex the foot, in order to relax the extensor tendons; an incision about two inches and a half long should be made through the integuments in the course of the artery, which may be ascertained by feeling its pulsation, or by observing the line of the tendon of the extensor pollicis proprius, on the fibular side of which it here lies; the fascia of the leg should be next divided to the same extent; it may in some cases be advisable to make a short transverse division of this fascia: the tendon on each side should then be held aside with a broad curved retractor, and on removing a little cellular membrane the nerve is brought into view, beneath which lies the artery with its venæ comites; these are

to be separated from the artery, and the aneurism needle passed round the latter; the nerve in this situation is usually superficial to the artery, it is however uncertain.

In case of a wound of this artery on the instep the vessel can be easily tied, either by enlarging the wound, or by making a fresh incision on the fibular side of the tendon of the extensor pollicis proprius muscle, taking care to avoid the first or the internal tendon of the extensor digitorum brevis. In consequence of the free communication between the anterior and posterior tibial arteries, it will be prudent in case of wound in this situation to tie both ends of the divided vessel.

The anterior tibial artery in some subjects is very small, so that when it has arrived near the ankle it is nearly exhausted; in such cases I have always found that the anterior peronæal artery is proportionably large, and joins the anterior tibial near the ankle, and thus compensates for the unusual small size of this vessel. The anterior tibial is sometimes wanting, even in the upper part of the leg, its place being then supplied by perforating branches from the posterior tibial artery.

GENERAL OBSERVATIONS.

THE student having concluded the dissection of the arteries of the pelvis and lower extremity, may reflect on the various inosculations that exist between these vessels in the different regions of the groin, thigh, popliteal space, leg, and foot; and as in the upper extremity he could trace one chain of anastomoses from the neck to the hand, in like manner, in the lower extremity a free vascular communication exists from the pelvis to the foot; so that if the main artery of the limb be obstructed in any part of its course, numerous opportunities are immediately presented for the establishment of collateral circulation.

There is a striking analogy in the course and distribution of the blood-vessels in the superior and inferior extremities. In both a large trunk pursues an undivided course for a considerable length of way, giving off comparatively but few branches, except in particular situations; thus around the shoulder and in the axilla there are arteries of considerable size; so from the groin, around the hip, the femoral artery sends off its largest branches; in both regions these vessels hold numerous communications with each other, and with arteries from different and distant sources. The arteria anastomotica from the femoral, resembles that from the brachial in its course and in its communications. The recurrent arteries around the elbow have some resemblance to the articular arteries of the

knee-joint; and the three divisions of the popliteal artery are essentially the same as the radial, ulnar, and interosseous branches of the brachial artery. In the foot, as in the hand, the principal branches supply the flexors, and comparatively few are distributed to the extensors. In the sole of the foot and on the toes, as in the hand and fingers, the arterial vessels have a similarly free communication, their anastomoses forming arches; these, however, are not so numerous in the foot as in the hand; in the latter there are two distinct arterial arches, a superficial and a deep;* in the foot there is but one, and this placed at a great depth from the surface, although there is a considerable quantity of muscular substance in this region. The difference in the number of vessels then in the foot and hand is not proportioned to the quantity of muscular substance to be supplied, but appears to depend rather on a difference in their function, the muscles of the foot being always very limited in their contractile powers, while those of the hand are capable of performing a greater number of motions, and those more complicated and delicate than any other muscles in the body.

All the anastomoses between the femoral and other arteries may be naturally divided, as Scarpa observes, into two orders, the one including the inosculations which take place between the arteries of the parietes of the abdomen and thorax, and of the inside of the pelvis, and branches of the femoral artery; and the

* See page 188.

other including those which occur between the femoral and profunda arteries along the thigh, and around the knee.

The first order of anastomoses must be of essential service in conveying blood to the femoral artery in case the external or common iliac has been obliterated. The second will serve to convey blood to the limb when the femoral artery has been obstructed in any part of its course.

Whenever the external iliac artery has been obliterated, blood will be conveyed to the lower extremity from different sources, namely, the circumflexa ilii, the superficial and deep epigastric arteries; the communications of these with the internal mammary, intercostal and lumbar arteries, will assist in supplying the femoral; the obturator, glutæal, sciatic, and pudic, through their communications with the circumflex branches of the profunda, must also be of essential service in conveying blood to the arteries of the thigh. These last named inosculations are the principal sources of supply in case the femoral artery has been tied above the origin of the profunda.

Whenever the femoral, or more properly the crural artery, shall have been obliterated below the origin of the profunda, then the supply of blood to the thigh and leg must depend on the second order of anastomoses; these are so obvious, and have been so frequently alluded to before, that it is unnecessary now to describe them particularly: posteriorly the perforating arteries communicate, not only with each other from the upper to the lower part of the thigh, but also superiorly with the

arteries of the pelvis, and inferiorly with the popliteal artery; anteriorly the descending branches of the external circumflex artery inosculate with the articular arteries, and there are numerous communications of the small branches of the femoral artery in the integuments and muscles, on the periosteum, and in the substance of the bone, with each other, and with branches of the profunda, and with the articular branches of the popliteal artery.

The number of minute anastomoses along the limb is totally incalculable; these in addition to the more obvious inosculations between the larger branches, are fully sufficient to convey blood to the popliteal artery, and so to the arteries of the leg and foot, in case disease or accident should cause any impediment to the flow of blood through the common or external iliac or through the femoral artery.

THE END.